2372 S

TN
/
M655
v. 1

The Mining Magazine

Edited by T. A.

PUBLISHED AT SALISBURY HOUSE, LONDON.

INDEX TO VOLUME I.

FROM SEPTEMBER TO DECEMBER 1909

EXPLANATORY NOTE.—Items in italics are names of books; illustrated articles are denoted by asterisks (*); the letters (*c.l.*) refer to notice of articles under the heading 'Current Literature'; the letters (*p.t.*) to abstracts appearing in 'Précis of Technology.'

112274

The Mining Magazine

Vol. I LONDON, SEPTEMBER, 1909 No. 1

Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager

PUBLISHED (BY THE MINING PUBLICATIONS LTD.) at 819 SALISBURY HOUSE, LONDON, E.C.

Telegraphic Address: Oligoclase. Telephone: 8938 London Wall.

BRANCH OFFICES: SAN FRANCISCO, CHICAGO, NEW YORK, MEXICO CITY, JOHANNESBURG

SUBSCRIPTION RATES.

United Kingdom, 12 Shillings (Single Copies 1s.) ... ... Abroad, 16 Shillings (Single Copies 1s. 4d.)

CONTENTS.

REVIEW OF MINING

It has been said that Britons take their pleasures sadly; it is more obviously true that they take their holidays religiously. Therefore, at this season the City lacks the presence of the energetic spirits who are at the seaside or on the moors, renewing their youth in preparation for the winter campaign. Thus there is a lull in the mining market, which, however, is in a decidedly healthy condition. In the early summer, as indicated by the calendar and not by the weather, there was sufficient speculative activity to warrant talk of a 'boom,' especially in the Kaffir circus, where prices rose cheerfully, and in the American department, where the quotations for half-a-dozen celebrated mines reflected a renewal of interest on the part of the public. General financial and industrial conditions are healthy, so that a reasonable optimism prevails.

As is indicated by the letter from our Johannesburg correspondent, the mining industry of the Rand is undoubtedly prospering, having passed successfully through the troublous period of labour unrest and political uncertainty. The production of gold continues to increase and is now at the rate of 7,125,000 ounces or £30,000,000 per annum. During July there was anxiety on account of the shrinkage of labour supply, owing to the customary return of many Kaffirs to their farms, but this apparent shortage was due more to the needs of an expanding industry than to any serious diminution in numbers. In July 1908 the Rand employed 149,000 Kaffirs and 19,000 Chinese; in January 1909, the natives numbered 169,500 and the Chinese 11,500, making 181,000. In June the natives had increased to 176,000 and the Chinese had dwindled to 5,500, leaving the total almost unchanged at 181,500. In 1906 the Chinese importation gave 53,000 labourers to the Rand, but this is now a story of the past; the remaining Chinese will soon be going. They saved the Rand pending the recruiting of natives, a process that has proceeded steadily, so that between January 1907 and June 1909, there has been a gain of 72,000 Kaffirs. It remains for the managers to increase the value of this industrial implement by training the natives to greater efficiency. Next to the labour factor comes the consolidation of companies whereby the costs of administration are being decreased by centralization of management. At the same time old mines are being strengthened by alliance with fresh claim-areas and large milling plants are assured of a continued supply of ore. One of the latest fusions is between the Geldenhuis Deep, Jumpers Deep, and Geldenhuis Estate; it is also announced that the Rose Deep and Glen Deep are to consolidate, while Rand Mines is to acquire Rand Mines Deep. The Crown Mines flotation marked the amalgamation of an important group and it is apparently a settled policy, especially with Wernher, Beit & Co., to induce economy by this process of reducing the expenses of maintenance and administration. Working costs on the Rand are now about 17s. per ton, a notable improvement on the average of 28s. per ton prevailing before the War. The general effect of the application of sound financial and expert metallurgical knowledge to mining in the Transvaal has been to place the industry on a peculiarly sound basis and to diminish the speculative aspect of ownership in Kaffir shares.

Announcement of another 'banket' discovery is made from Rhodesia, this time at Abercorn in the Mazoe district, 60 miles north-east from Salisbury, in a region fairly well watered. Ore has been found on ground near the holdings of the United Rhodesia Goldfields, a company formed in 1894; the importance of the discovery was recognised in spring and attracted the attention of engineers in the employ of the Consolidated Goldfields of South Africa, which company has now acquired options on most of the ore-bearing ground, in the name of the Abercorn Syndicate and the Abercorn Extension Syndicate. Specimens from this find show free gold in a conglomerate or breccia; it is not certain that the deposit is a 'banket' formation, the few openings on a hillside being as yet insufficient to disclose the geological nature of the occurrence. In Rhodesia also the consolidation of companies is in progress,

No. 1 Incline shaft of the Robinson mine.

the most notable being the fusion of the West Rhodesia Banket, Lomagunda Development, and the Goldfields of Matabeleland; the consolidation was effected by Mr. Abe Bailey and is named the Amalgamated Properties of Rhodesia. We hope this example will be followed by others, for, of all modern gold mining regions, Rhodesia has suffered most from amateur mining.

West African gold mines have received renewed attention owing to the entrance of Wernher, Beit & Co. into the 'Jungle'. This firm has secured a controlling interest in the Prestea Block A and the Fanti Consolidated, retaining Walter Broadbridge as general manager. The Consolidated Goldfields of South Africa had previously acquired an interest in the Abbontiakoon, Prestea Block A, Wassau, Effuenta, Wassau West, Fanti, and Cinnamon Bippo, all of these holdings being consolidated under the name of the Gold Coast Amalgamated Mines, of which Robert G. Fricker is managing director. Thus the two great South African financial firms have entered the West African goldfields; the result will be to stimulate operations both at the mines and on the share market. It is interesting to note also that a West Australian company, the Great Fingall, is providing working capital for a consolidation consisting of the Tarkwa Main Reef, Ashanti Gold Coast Acquisitions, and the Wassau Extended. In this district only the Taquah Exploration and the Abosso are milling 'banket'; all the other companies are engaged in exploratory work, so that next year should decide the relative importance of this gold deposit. The most important recent development in West Africa is credited to the Ashanti Goldfields, where on the 300-ft. level of the Justices mine the main lode has been cut and assays prove an average of 11 dwt. per ton. West African mining should now develop into a profitable industry, if proper care is given to the extermination of the mosquito, as urged on another page by Mr. J. H. Curle.

At Broken Hill the parent mine is practically idle, pending a rise in the prices of metals. This suspension of operations has followed upon the labour strike, which ended in an appeal from the Arbitration Court to the High Court upon points over which the lower court was considered to lack jurisdiction. This higher court gave a decision favourable to the Broken Hill Proprietary Co. and the men have accepted the situation. At present, however, only 1,800 men are employed as against 4,400 previously, operations being confined to some mine development and to the zinc concentration mill, which is treating the accumulation of old jig-tailing. The company is buying lead concentrate from the neighbouring mines and shipping this product to its smelter at Port Pirie. Incidentally, it may be added that a conference was held in Paris by the directors of this company, to arrange for an even range of metal prices; this meeting was officially claimed to have been successful, but we have reason to know that it was a failure and contributed to the decline in the lead market.

At the neighbouring mine of the British Broken Hill company, the mill is being reconstructed and the mine itself is undergoing development, without production. A vacuum-oil plant is being added to the mill, but here also there is no hurry to resume production until lead and zinc have risen in price, for the grade of the ore reserves is too low to permit of profitable exploitation at present. This applies also to Block 14, where the mill is idle while the mine is undergoing development, the production being confined to oxidized ore gleaned from the old shallow levels of the mine. The ore is sent to Port Pirie. On the South Blocks excellent work is being done, a feature of the mill-treatment being the classification by revolving screens of the Callow type, but modified to suit local conditions, particularly the acid water. At the Central a new and promising lode has been cut west of the main orebody on the 1,100-ft. level. Block 10 is running at full blast; stoping is in progress from the 1,400-ft. level upward, the product of the mine being treated at this company's mill at Broken Hill, while the concentrate resulting is shipped to the Proprietary's smelter at Port Pirie. One of the old mill-dumps has been sold to the Zinc Corporation and the other to the De Bavay Treatment Co., which, by the way, is soon to be reconstructed and listed upon the London market. This company has a large mill in process of erection on the ground of the North Broken Hill Co., the experimental plant started four years ago by De Bavay having grown into an important establishment warranting further expansion. It is understood that the De Bavay company has from three to four million tons of tailing available for treatment. The Zinc Corporation is handling 20,000 tons of tailing per month and is earning handsome profits, the first dividend of 12½% on the preference shares being payable during the current month. The resuscitation of this important enterprise is one of the most cheerful events in recent mining finance and reflects credit on those who had the courage to persist against apparently insuperable obstacles.

In Western Australia the news of progress relates almost exclusively to a group of large properties, no new mines of any consequence having been developed for several years, despite active prospecting. However, the exploratory work in hand gives promise of success, especially in the Murchison goldfield. At Kalgoorlie, the big mines of the Golden Mile continue to be richly productive, the leaders at this time being the Golden Horseshoe, Great Boulder, Ivanhoe, and Kalgurli. The recent discovery of rich ore, carrying free gold, on the 2,600-ft. level of the Great Boulder has stimulated the stock market. This is the deepest mine in Western Australia, although the Ivanhoe, with rich stopes at 1,970 feet, and a shaft now past 2,100 feet, is also notable in this respect. The development of the south end of the Kalgoorlie district gives promise; in this connection the recent work in the Chaffers, Boulder Deep Levels, and Hannan's Star is worthy of mention. The labour situation is now satisfactory. As regards metallurgical development, the most important feature is the general adoption of the vacuum-filter for the treatment of slime, replacing the filter-presses of the old pressure type, such as the Dehne and the Johnson.

Outside of Kalgoorlie, the Great Fingall has found some ore at 2,200 feet, after passing through a barren zone that threatened to end the life of this mine. The new ore-body, however, is small and can only be taken as a promise of improvement. The Sons of Gwalia is doing well; the shaft has been sunk to 2,200 feet and further sinking is in progress. At 2,100 feet the developments indicate that the orebody maintains its size and value, while the new ore-shoot at the south end of the mine is proving of good grade. The 50-stamps treat 13,000 tons per month, a fact of which the management is proud. The Northern Mines at Lawlers, formerly the East Murchison United, is opening up the Warrunga leases, and the 40-stamp mill is crushing ore steadily. The Lancefield has recently passed through anxious times, but the problem of ore-treatment appears to have been solved. While the 'outside' districts contribute only a small quota of the gold product of West Australia, it is gratifying to note that systematic exploration continues. The London, Australian, & General Exploration Co., which is the successor, by reconstruction, of the old London & Western Australian Exploration Co., retains large interests in some of the bigger mines and follows the policy of developing claims before flotation. The Oroya Brownhill is likewise doing much useful exploratory work in the State, having under option the Mountain Queen mine at Southern Cross, the Great Western at Youanme, the Moonlight at Lake Way, and other promising young mines. Our readers are also aware that this enterprising corporation has acquired the Leonesa mine in Nicaragua, so that the corporate existence of the Oroya Brownhill promises to be long and lively.

From Mexico the most interesting news relates to the negotiations of the Camp Bird company for the acquisition of a mine at Pachuca. The Camp Bird, at Ouray, Colorado, it will be recalled, was bought from Thomas F. Walsh in 1902, after negotiations beginning in 1900. The Venture Corporation were the vendors to a company capitalized for £1,100,000, in 1,100,000 shares, of which 820,000 have been issued. The price of the mine was £801,163, Mr. Walsh being further entitled to 25% of the profits up to a sum of £400,000, which he has now received. This mine proved a rare success; up to July 31 the production has been £3,030,800, dividends amount to £1,148,000, and there is £300,000 in hand. But this mine, like any other, cannot last for ever, and, after years of prolific production, gives signs of waning. Therefore the directors decided to acquire property elsewhere, thereby prolonging the life of the enterprise and utilising the technical skill now in their employ. An option was obtained on the La Blanca mine in the cele-

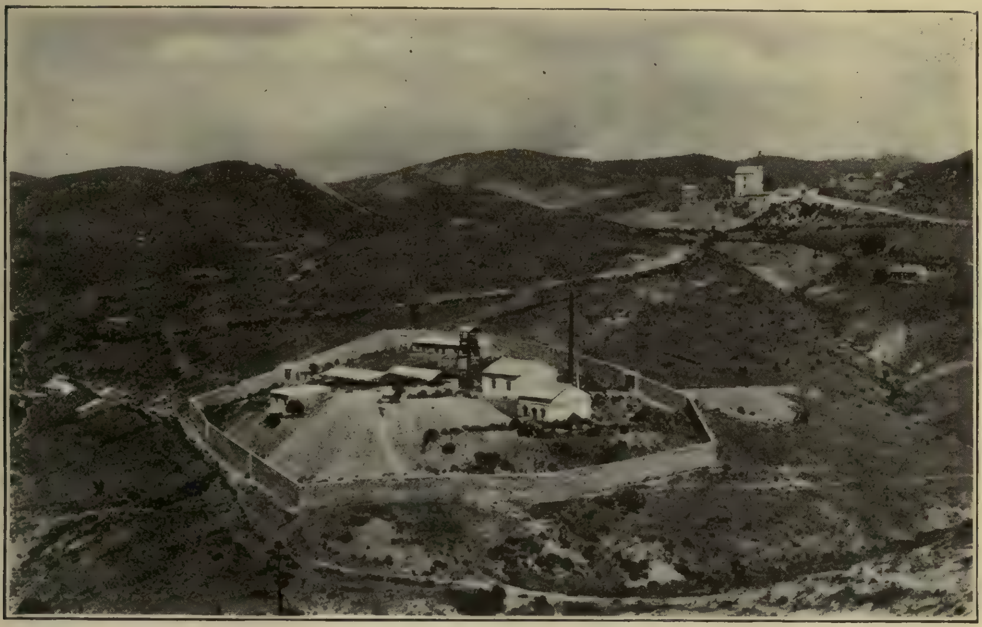
The Village Deep mine, Johannesburg.

brated old district of Pachuca, in the State of Hidalgo, Mexico. This option was not exercised, because investigation showed that the vein dipped into the neighbouring ground of the Santa Gertrudis ; thereupon negotiations were diverted to the Santa Gertrudis and at the end of August a four months' option was obtained on payment of a deposit of $100,000. The purchase price is $4,500,000 (American currency), the working capital required is $750,000 ; therefore $5,250,000 is needed in cash. Arrangements have been made for finding this money ; the new company will have a capital of £1,300,000, of which the Camp Bird will hold £1,136,000 in £1 shares. The Santa Gertrudis has an orebody 1,600-ft. long, from 18 to 24-ft. wide, averaging $30 per ton, of which 75% is in silver and 25% in gold. As regards the examination of the Santa Gertrudis, it may be stated that the interests of the Camp Bird shareholders were in the capable hands of R. J. Frecheville, assisted by W. J. Cox, the manager of the Camp Bird. We may add that John Hays Hammond and Cortlandt E. Palmer "engineered the deal," an American phrase that expresses the useful work done by engineers who also act as promoters.

Camp Bird shares have been strong recently partly on expectation of this business and partly on the returns from the mine. During the past six months the profits have been £260,000, that is, £100,000 more than the normal rate of dividends at 20% or £164,000 per annum. These high returns are due mainly to the milling of ore from old stopes above the Chicago tunnel, where rich ore broken several years ago has now become available in the ordinary course of extraction. Reserves of broken ore in the stopes have formed a peculiar feature of the Camp Bird reports and the shareholders are now having their profits sweetened from this source. In the lower levels there are no new developments and there is no valid promise of the persistence of the rich veins worked in the upper horizon of the mine. Hence the diversion of capital to Pachuca ; it is a sound policy.

The mines at El Oro are doing well. In the El Oro mine itself there is nothing new to report ; the sulphide veins in the Somera ground, at the 1,000-ft. and 1,150-ft. levels, are delayed in development pending the sinking of a new shaft at the north end of the company's ground. This shaft is now 550 ft. deep and will afford improved ventilation, as well as facilitate pumping operations. In the Esperanza the deepest exploration is on the ninth level, where a winze is being sunk in ore. According to the latest estimates the ore reserves stand at 238,000 metric tons, which is one year's supply for the reconstructed mill. This mill contains 10 tubemills and will have a capacity of 20,000 tons per month, as compared to the old mill, which treated 13,000 tons monthly. In the adjoining Mexico mine rich ore has been struck on the seventh or bottom level. The ore is 15 ft. wide and assays 2½ oz. gold and 20 oz. silver per ton. This was struck only 50 ft. from the boundary of the Esperanza, in which mine the same orebody was cut on the eighth level, which is 25 ft. deeper than the seventh in the Mexico. As far as known this sulphide vein, which lies in the hanging or west side of the San Rafael lode, will prove profitable for only 100 ft. overhead, but the prospects are good in depth. Rich ore has also been found in a branch vein on the fifth level of the Mexico at the extreme north end of the property. The returns have improved lately, both as to tonnage and profit. In July 11,761 tons were extracted, yielding a profit of $64,590 from ore that averaged $9·02 per ton. The working cost was only $3·94 per ton—a result highly creditable to the management.

Among Indian gold mines, the only important development is in the Champion Reef. The grade of the ore began to fall away in 1906 and instead of a yield of 1¼ oz. per ton as formerly, the recovery fell to 14 dwt.; at the same time the tonnage was curtailed from 215,000 to 170,000. The monthly yield is now 9,500 oz. During the last few months some 1¼ oz. ore has been found on the 3,000 ft. level, the deepest portion of the mine, and there is some possibility that the output will be increased before long. The dividends now paid by the company are at the rate of 20%, which is only one-eighth of the rate four years ago. Even now the shares of the company stand at a high premium, the quotation being about 10s. for the half-crown share. It is obvious that the shareholders are "sitting tight." The Mysore, Ooregum, and Nundydroog mines continue to open up well; the monthly yields are steady at 19,000 oz. from the Mysore and 7,300 oz. each from Ooregum and Nundydroog. At the Mysore developments are excellent in the Ribblesdale and Tennant workings, but the McTaggart ground, which has in its time yielded much high-grade ore, shows signs of exhaustion. No new additions to the mills have been made recently, with the exception of a cyanide plant to treat the accumulated tailing at the Dharwar Reefs. It is reported that the newly-opened mines on the ancient workings at Anantapur, Madras, give promise of another goldfield of importance.



In the Pachuca district, Mexico.

From Vancouver comes the news of the wreck of the *Ohio*, which was wrecked off Ketchikan, Alaska; luckily, most of the passengers were rescued. This vessel was unfortunate last year in being caught amid the ice-pack when going to Nome. From Nome we learn that there was more prospecting last winter than in any winter since 1905, when the third beach was discovered. The tundra between the Snake and the Nome rivers, and from the sea-shore to the hills, is being carefully prospected in the search for further ancient-beach concentrations of gold.

At Juneau there has been some excitement by reason of a find of gold ore 12 miles west of the town; the lode appears to be in the schist belt that flanks the coast. The Perseverance mine, in Silver Bow basin, is supplying its 100-stamp mill; the ore is said to average 3 dwt. per ton for a width of 80 feet, and affords the basis for large operations.

At Dawson the summer opened cheerfully and there is plenty of water. Ten dredges are at work, the ground being thawed with steam-points preparatory to digging. The big ditch of the Yukon Gold Co. has been tested by the admission of water, but the lack of pipe to complete the delivery to Bonanza creek has delayed hydraulicking operations. The electric elevators, that is, bucket-chains operated by electrical power, are doing well this season. The search for gold-quartz veins continues, and some good prospects exist on the divide between Hunker and Bonanza creeks. From Fairbanks also comes news of 'quartz' discoveries, but these will require further confirmation, for so many alleged goldbearing veins have proved to be merely 'float' or else sandstone speckled with pyrite. Lode mining in the interior of Alaska is still only a potentiality, but we believe that gold-quartz in place and in profitable proportion is sure to be found, as at the Great Hurrah mine in the Solomon district. The placer deposits of the region are so rich and so widely scattered as reasonably to warrant this expectation.

It is satisfactory to note that the American group of mines is doing well and receiving the support of the public; we refer to the Camp Bird and Tomboy in Colorado, the Mexico, Esperanza, and El Oro in Mexico, and the three big mines at Treadwell, Alaska. The last-mentioned constitute a near approach to real investments, having large low-grade deposits of gold ore that can be treated cheaply. A rise in quotations has reflected an improvement in the returns, as is indicated herewith:

ALASKA TREADWELL.	Tons	Profit	Yield per ton	Cost per ton
June 1908	78,988	$89,314	$2·22	$1·09
July ,,	79,191	79,751	2·08	1·07
June 1909	88,284	185,000	3·21	1·11
July ,,	80,052	158,870	3·12	1·14
ALASKA MEXICAN.				
June 1908	23,568	21,681	1·96	1·04
July ,,	24,124	24,295	2·20	1·19
June 1909	20,118	58,103	4·30	1·41
July ,,	19,173	54,192	4·20	1·37

It is obvious that the Alaska Mexican has been winning ore twice as rich as a year ago at about the same cost, the slight increase in the cost per ton being due to the smaller tonnage treated. At the Alaska Treadwell the yield has increased about $1 per ton or nearly 50%, while the cost per ton has diminished, in consequence of handling a bigger tonnage. The control of these mines is vested in an American company having its head office at San Francisco, with shareholders in England and in France. D. O. Mills is the directing personality and F. W. Bradley is consulting engineer.

Our Cornish correspondent sends us the latest news from the 'old county.' There is not much to tell, the only work of world-wide interest being at Dolcoath, where the new vertical shaft is being sunk to 500 fathoms, or 3,000 feet, preparatory to the economic extraction of ore previously found by explorations in the workings leading from the old incline shaft. The orebody at the bottom of Dolcoath is 34 feet wide of stuff containing 225 pounds of black tin, or cassiterite, per ton; this is the equivalent of 2½ ounces of gold per ton, so that this body of tin ore may well be compared with the 35 feet of 50 dwt. gold ore at 2,000 feet in the Ivanhoe, at Kalgoorlie.

EDITORIAL

THE PURPOSE of this periodical is to be useful to those engaged in mining. To be useful, a publication must be interesting, and to be interesting it must be truthful. By affording accurate and unprejudiced information on the various subjects pertaining to the technology and business of mining, we hope to win the support of the large number of earnest men engaged in one of the basic industries of civilisation. This magazine is controlled by the editor; it is therefore free to pass fair criticism, just condemnation, or sincere praise upon any action or event affecting the integrity of the mining profession or the development of the mining industry.

MEMBERS OF THE STAFF of this magazine will not buy or sell mining shares, nor do they own any at this time. This decision is the result of experience elsewhere, it having been proved that clearness of judgment in mining affairs and independence of criticism in financial matters can best be achieved by complete detachment from stock-jobbing of every kind. Journalism has suffered from the temptations of share-gambling, and is suffering from them to-day; it is well to recognise that we are human, by avoiding pitfalls likely to engulf others besides the unwary. The rewards of the stock-market are won at a heavy price by editors to whom speculation proves alluring, for it leads to a diversion of the energy required for their proper duties and to a subservient attitude toward those in control of mining finance. An editor must be independent; independence is not compatible with gambling.

DISCUSSION is the whetstone of thought; by exchange of ideas the wits of the engineer are sharpened and his methods shaped to an economic purpose. We welcome to these pages the free expression of opinion and criticism, whether bearing on matter we ourselves publish or relating to subjects not thus introduced. We particularly wish it to be understood that opinions contrary to our own will be published with alacrity, because they are likely to prove interesting to our readers. Let us have discussion that is not desultory and criticism that is penetrating but polite.

AMONG THE CONTRIBUTORS to this issue is Mr. J. H. Curle, the author of 'The Gold Mines of the World,' a traveller, mining engineer, and writer whose outspoken utterances have impressed the Public and the Market more than once. We publish a valuable technical article by Mr. Henry F. Collins, author of 'The Metallurgy of Lead and Silver,' a metallurgist who has accomplished important work in Spain, Mexico, and Australia. Those who live on the Rand will read with interest the criticisms contributed by Mr. T. Lane Carter, an American from the genial South, who, after ten years residence at Johannesburg has returned to his native country. The article on the oil-flotation processes was prepared by Mr. Edward Walker, assistant to the editor of this magazine.

AN EXAMPLE of the irregularities that injure legitimate mining is afforded by the Globe & Phœnix, a company operating in Rhodesia. On September 3 the directors gave out information concerning the discovery of rich ore in the bottom workings of the mine. This news had leaked out and was the cause of share-dealings fully two months earlier; in fact, so long ago that profits had been taken by well informed speculators many weeks before the shareholders got the news. The cablegram given to the Press says that "140 ft. has been driven south" in the ore and a connection has been made with a winze. This work could not have been done in less than two months, during which persons better informed than the owners (that is, the shareholders) of the mine were able to speculate profitably on the London market. The news is unusually important because the vein had been cut off by a dike that threatened to end the life of the mine and this recent discovery relates to the finding of ore under that dike. Directors are trustees for the shareholders; they are not privileged speculators.

WE HOPE that both Cook and Peary will establish the fact that they reached the North Pole; our reasons are various, the chief being the desire to see an end to the silliness of the Arctic hippodrome, with its mixture of pseudo-scientific exploration and newspaper notoriety, the object of which is to sell useless books. Arctic exploration was useful as long as it meant the search for a northwest passage; it ceased to be of any real interest to humanity when that passage had been discovered by Amundsen, and it became simply a scramble for fame as soon as the North Pole only was the object of voyages that consumed money and energy to no purpose. The same is even more true of the South Pole. What has been, or is to be, gained from the spectacular effort to be first on an imaginary spot in the heart of a wilderness of ice? It is no more useful than climbing a church steeple to win the plaudits of the crowd. Even the hardships are exaggerated; we know plenty of plain men who have journeyed for hundreds of miles over the arctic portion of Alaska, without notice, without fuss, but in pursuit of a sane purpose, namely, the exploration of a region in which human industry is possible. They were prospectors, not lecturers; they were miners, not heroes. The sooner both the Poles are reached the better; it will end the pseudo-scientific activities of newspaper syndicates and the mock-heroic antics of notoriety-hunting lecturers, who have too long trespassed on the simplicity of the public.

RAPIDITY OF TRANSPORT across the Atlantic is essential to commerce, therefore every shortening of the voyage between Europe and America is a matter of general interest. The reduction in the time of transit has done a great deal to promote both business and international good feeling by rendering it easy for travellers to go from one side to the other. Recently the *Mauretania* broke the record by making the crossing from New York to Queenstown in 4 days 14 hours. Concurrently the decision to land passengers at Fishguard, instead of Liverpool, expedited the arrival at London so that the journey from New York to London was completed in 5 days 1 hour. Passengers leaving New York at noon on Wednesday, August 24, reached London at 7.28 p.m. on the following Monday. As the mail train preceded the passengers, letters from New York were delivered before 10 o'clock. Thus the delivery of mail was effected in 5 days from New York and 10 days from San Francisco. The *Mauretania* averaged 25·41 knots or 28½ miles per hour, and the train from the landing-stage to London covered the 260 miles at the rate of 57 miles per hour. Thus are time and space conquered. The end is not yet. Further saving of time can be effected by landing mail at the eastern end of Long Island, thereby eliminating the time lost between Sandy Hook and the New York pier. The feat of the *Mauretania* has particular interest at a time when our friends in America are celebrating the centenary of

Fulton's first voyage in a steam-propelled vessel on the Hudson river. Only 90 years ago the *Savannah* crossed the Atlantic in 26 days, arousing the astonishment of the civilised world. There is reason to expect that the crossing will be made by steamships in 4 days. After that the airship.

AT THE RECENT SUMMER MEETING of the Royal Institution of Cornwall, held at Levant mine, under the presidency of Mr. Richard Pearce, a number of distinguished Cornishmen recalled old memories and exchanged friendly courtesies. Among these was Captain Francis Oats, who won fame and fortune at Kimberley. As a successful product of early attempts to give a scientific instruction to young miners, Captain Oats stood up for the 'old county' and said that "although Cornish mining was proverbially scorned by people who were mere tyros in mining experience, they had yet to see a foreigner, either from the great Republic or elsewhere, come to Cornwall and make the mines pay better than Cornishmen." In view of some grandiose schemes recently started in Cornwall, and of the failures recorded, there is some point in the Cornishman's rather indignant assertion of his knowledge of the business in which his people for generations have been trained. Our own experience goes to show that the Cousin Jack is strong underground and weak on surface; he knows how to get ore and break it better than anyone, but when the ore is raised to the surface, he handles it expensively and inefficiently as compared to his friends in America, Africa, and Australia. But the Cornishmen are the miners of the world; any mining district in which there are no Cousin Jacks, and in which none have been, will show signs of it underground. We are reminded of a story that W. J. Henwood used to tell; it related to three famous mine-captains: Joseph Vivian, Nicholas Vivian, and William Thomas. In consequence of a friendly dispute it was arranged that Captain Nicholas and Captain Will should have a ploughing contest, with Captain Joe as umpire. When the trial was ended, the umpire gave his decision thus: "William, thee's the worst plougher I ever did see; but Nicholas, thee cousent plough at all." It is not necessary to emphasise the analogy.

THE DAILY PRESS of Great Britain, on the whole, maintains a dignity and character worthy of the highest traditions of honourable journalism. Nevertheless, the selling of reading space for advertising purposes is a blemish from which few newspapers are free. Even *The Times* charges for descriptive articles. Evidence of this fact became public when, on July 24, the proprietors of *The Times* sued an engineering firm in the Court of King's Bench for £60, the price of a laudatory article appearing in the 'engineering supplement' of *The Times*. The point in dispute was not the general question of paying for a reading notice or 'write-up,' but the claim was made by the defendants that the contract provided for commendatory mention in the form of a 'leader' or 'editorial.' The representatives of *The Times* argued that no paper would agree to such terms as these; the Court accepted this view, and the engineering firm had to pay the bill. Thus it became manifest that *The Times* will sell reading space, though it draws the line at leading articles. Surely it is high time that such questionable practices should be dishonoured and discarded; all matter for which payment is received should be marked plainly as 'advertisement,' so that the reader of newspapers may know what part of the information is prejudiced, and what part of it is unprejudiced, by monetary considerations.

However, it is a pleasure to recognise the extraordinary high level maintained in the editorial comment of the leading newspapers of London, and to express gratitude for the fine literary quality of such papers as the *Daily Telegraph*, *Morning Post*, and *Spectator*. A great gulf, fortunately, separates journalism of this kind from that of San Francisco, for example, where the daily Press is merely a vehicle of misinformation, and a panderer to sensationalism, if not worse. It was proved in court about a year ago that the San Francisco *Chronicle* received $10,000 from a telephone company as a payment for "educating" the public, not by meretricious leading articles, but by 'doctoring' the news items appearing in that paper. Thus the people of San Francisco not only read prejudiced editorial comment, but the very fountain of information—the current news—is polluted at its source. This serves to mark how low journalism can sink, and should warn every newspaper proprietor that the editor's room and the counting-house be kept separate.

ENGINEERING is exhibited as a benefactor to civilisation in the annual report of the Board of Trade giving the statistics of railway accidents. It is a gratifying fact that not a single passenger was killed during 1908 on the trains of the United Kingdom, and only 283 were injured, although 1,278 million journeys were made, exclusive of journeys by season - ticket holders, of whom there were 721,000, so that 450 million more journeys must be added; thus 1,728 million journeys were made by train without the loss of a passenger's life. In other accidents, not on trains, but due to the railway service, only 102 passengers were killed and 2,242 injured, but trespassers (including suicides) killed numbered 479 and injured 118. Casualties among certain classes of railway employees are relatively numerous, averaging 1 in every 18 for guards and brakemen on goods trains, and 1 in every 14 for shunters. These men are just as much deserving of medals and pensions as soldiers or sailors.

VALUATION OF MINES, and the estimation precedent to such onerous exercises, has again formed subject for discussion, as is shown by an abstract appearing on another page of this issue. As yet the efforts to differentiate between ore measurable and ore conjectured have not sunk deeply into the intelligence of the public and we venture to advise professional men not to assume that their clients will pay adequate attention to the niceties of distinction between ore that is 'proved,' 'probable,' and 'possible.' The riotous imagination of the average shareholder readily converts the 'possible' into the 'probable,' when it does not transmute the impossible into the commonplace. We are prompted to refer to this matter because we happened to see, recently, the longitudinal section of a young mine in which several adit-levels had demonstrated the length of an orebody without testing its persistence in depth; in other words, there were no winzes. Nevertheless, the engineer assumed 50 feet below the bottom of the level and indicated the block thus estimated by a delicate shading in pink. It is true this supposititious mass of ore was labelled 'probable' and in another section a farther extension downward was marked 'possible,' but we hazard the conjecture that in the mind of the client or shareholder the rectangular spaces cheerfully indicated in pink will be regarded as sources of future wealth as safe as the rock of Gibraltar. The moral is: Do not represent diagrammatically what is imaginary in a mine; give such definition to ascertainable facts only. It is safer and saner to state in words that, given an orebody of known length and width, if it persist downward the ore reserves will be increased so many tons for each ten feet or for each 100 feet of depth. Leave the tinting and other graphic exercises for the ore that has been actually proved by drifts, winzes, and cross-cuts. Tempt not the providence that watches over the simple-minded shareholder.

DISTANCE GIVES PERSPECTIVE, even in metallurgy; a change in the angle of vision often discloses features previously not detected; therefore when a cyanider leaves the Rand and goes to Nicaragua, his view of South African practice assumes a new aspect. Such is the case with the comment on 'Metallurgy on the Rand,' contributed by T. Lane Carter to this issue of our Magazine. We hope his criticisms may prove suggestive. As regards his recommendation of filter-pressing, it is fair to say that G. A. Denny tried the Dehne filters in the New Goch and the Van Ryn mills, with encouraging results as to extraction but at an expense almost prohibitive. Since then the Butters filter-press has been tested at the Simmer & Jack, the extraction being high, but the experiment was not arranged so as to give data on the working cost. There is good reason to believe that the suction-filters of the Butters or Moore type would give good service on the Rand. Another point raised by Mr. Carter relates to the use of steel in stamp-mill construction; we are informed that the use of steel in king-posts is not advantageous on the Rand on account of the vibration and the cost. It must be remembered that African practice has surpassed the American as regards weight of stamps, 1,600 to 1,800 pounds being customary on the Rand; indeed, stamps of 2,000 pounds are now being erected on the West Rand Consolidated. These are points on which there is room for differences of opinion, but there can be none as regards the usefulness of constructive criticism.

AN IMPORTANT libel case has recently been decided in the High Courts of Justice, the plaintiff being H. T. Marks and the defendants, Walter R. Skinner and *The Capitalist*. This newspaper had published a series of articles dealing with the promotion and management of the Bonmahon Copper Mines Development Syndicate, organised to acquire mining property in Ireland. Mr. Marks was the promoter and then the manager of the syndicate, and Mr. Skinner (who publishes the 'Mining Manual') is proprietor of *The Capitalist*. The articles forming the basis for the libel suit charged Mr. Marks with mutilating the reports quoted in the prospectus, with managing the mines to suit his personal ends rather than those of the shareholders, and, finally, with accepting commissions while in the employ of the company. On trial, Mr. Skinner claimed that his comments were true in substance and in fact; and the jury gave a verdict in his favour. We do not know Mr. Marks and we take no pleasure in his punishment, but we deem it proper to commend Mr. Skinner for the service he has done by his effective criticism. Unfortunately, because of the fear of libel proceedings and for lack of moral courage, it is seldom that improper practices in mining are exposed; when attacks are made they are too often merely the expression of personal hostility, business enmity, or blackmail. Reputable journals assuming the defence of the public interest by making criticism that is neither mean not malicious, but fair and frank, deserve to be supported. Therefore we thank Mr. Skinner for the performance of a public service.

Technical Journalism.

This periodical is designed to be useful to mining engineers and metallurgists, to the managers and superintendents of mines all over the world, to managing directors at home, and to other persons having an intelligent interest in the industry of mining. It will be no part of our purpose to tell people what shares to buy or sell, although we expect to give a great deal of information likely to prove helpful to those who want to know the physical condition of particular mines or the status of the industry in particular districts. This we say because, in the course of a recent conversation with a director of dominant position in the mining coterie of London, we were advised to publish a sort of investor's chronicle or a speculator's guide, that is, a paper interesting to such as dabble in mining shares. We were told that a paper devoted to the task of telling the man in the street what shares to buy or sell, why certain shares were low and others high, and so forth, would be a great success. To this we replied that if we possessed the discernment or inspiration required to equip us for the office of public mentor, we would make our own fortune first and then make enough more to present a Dreadnought to the nation. Not having either the genius or the inclination for such a performance, we thought it best to leave the stock-market tipping to the financial periodicals already established in the City of London. Indeed, the point here raised goes to the very basis of technical journalism. The mining papers of the better sort do not thrive on the support of the dabbler in the margins of the Stock Exchange, nor do they depend upon the subscriptions of other persons of a nondescript character; the monetary success of the best type of technical publications depends upon the fact that they are valuable mediums of publicity to those having machinery for sale, and the usefulness of the advertising pages is directly proportioned to the extent to which the reading matter attracts the attention of those likely to purchase machinery or likely to have a say in such purchases. A paper that is read by engineers, superintendents, directors, and other men occupying either executive or advisory positions in connection with mining operations, affords an effective vehicle for the offer of every kind of machinery required in the mine, mill, or smelter, because such men will look at the advertising pages of a paper for which they have respect, and they will keep for reference a periodical in which they habitually find trustworthy information. The stock-jobber, the punter, the shareholder, the other human units connected with the non-technical side of mining do not contribute to the success of a mining periodical as much as one manager who orders a winch from a firm advertising in that periodical. The failure to recognise this relation has robbed mining journalism in England of much profit and more dignity. For it is obvious that a paper dependent on the eccentricities of mining rather than its essentials is not likely to be read by those to whom is referred the choice of plant and equipment. However, the advertising must be kept separate from the reading matter; these departments must not overlap. All that the advertiser demands, or should demand, is that the reading pages will appeal to the men whom the advertiser, by his advertisement, wants to reach. Puffs disguised as information, or 'write-ups' masquerading as contributed articles, hurt the advertiser as much as they annoy the intelligent reader; such insincerities spoil the paper as a medium of publicity because they undermine the confidence of the reader. Therefore, it is for the editor to publish matter useful to those engaged in mining and it is for the business manager to invite the manufacturer of machinery to avail himself of the advertising pages. The two departments are separate, but co-ordinated; the independence of the one contributes to the service of the other. In *The Mining Magazine* no line of the reading matter will be for sale and no part of any advertising page will be gratuitous.

Royal School of Mines.

Some of our readers were privileged to be present on the auspicious occasion when His Majesty the King laid the foundation stone of the new building intended to accommodate the Royal School of Mines. A select company watched the ceremonial at South Kensington on July 8, and listened with profound respect to the interesting speech read by the King in response to an address from the Chairman of the Governing Body of the Imperial College of Science and Technology, the institution that represents the consolidation of the Royal School of Mines, the Royal College of Science, and the Central Technical College, the last of these being commonly known as the City and Guilds of London Institute. As stated, the ceremony was interesting, but to the former students of the Royal School of Mines it must have been depressing, despite the fact that it marked the beginning of a new and splendid building. The utter lack of sentiment either for the old School or the industry that it represents was painfully evident; the tickets of admission did not bear the name of the School of Mines, the foundation stone was similarly silent (although this blunder was subsequently rectified), the account in the daily Press next day omitted any reference to the School made famous by a long line of great teachers, and rendered illustrious by hundreds of graduates in every part of the world. Only in *The Morning Post* did we see any mention of the real meaning of the ceremonial. In *The Times* the Royal College of Music received as much mention as the School of Mines. For the rest, the magnificent names of the new consolidation bespattered the various accounts like those pathetically long titles given to asylums for the deaf and dumb, for inebriates, and others requiring eleemosynary aid. Even our contemporary, *The Mining Journal*, which is properly proud of being 75 years old, devoted a column to the affair without a single mention of the name of the Royal School of Mines. Therefore we say that it was not a cheerful episode to the old students, for it proves once again that either by inadvertence or intention the Royal School of Mines is to be smothered under the weight of its new associations.

Having made this protest we can proceed to dwell on other features of the event. The alumni of the Royal School of Mines are neither unreasonable nor ungrateful, little as they like the trend of development whereby their alma mater is steadily losing her identity. We believe that we interpret their feelings of gratitude to the members of the firm of Wernher, Beit & Co., for the munificent sums of money placed at the service of technical education in general and of mining in particular, by Sir Julius Wernher and his late partner, Alfred Beit. In fact, the presence of Sir Julius Wernher on the platform at South Kensington was the sole reminder of any connection between the new building and the mining industry. We were glad to see him there, for his generosity was, to the best of our belief, the one factor that saved the Royal School of Mines from extinction. The old students also feel grateful to the Council of the Institution of Mining and Metallurgy for an earnest effort to safeguard the best interests of the School, and they owe especial thanks to Mr. Walter McDermott for his devoted service on their behalf; they ask that the friends of the Royal School of

Mines, whether in office or not, will realise the importance of preserving the identity of the School, which had an honourable place long before the transformations that now threaten to smother it under a weight of pretentious names. As science is better than red tape, and men are more than buildings, so the traditions of Murchison, Ramsay, Percy, Tyndall, Huxley, Smyth, and Judd are greater than the agglomeration out of which the new Charlottenburg is to be evolved.

Machine-Drills v. Hand-Labour.

We note with interest that Sir Julius Wernher, in his comprehensive speech as chairman of the Central Mining and Investment Corporation, referred to the use of machine-drills by Kaffirs in the mines of the Rand. He testified that experience had proved hand labour to be more economical than machine-drills, despite every effort, by competition and bonus, to induce greater efficiency. This is not as surprising as it seems. The employment of cheap labour and the narrowness of the stopes on the Rand tend to lessen the efficiency of machine-drills; it is plain that in South Africa, as in Korea, Mexico, and India, the training of the native to the use of machines underground is at least as important as the purchase of the best drills. In comparing conditions in the Transvaal, where labour is cheap and unintelligent, with, for example, Alaska, where labour is expensive and moderately intelligent, we get some light on the subject. Taking the four big mines at Treadwell and comparing them with four typical mines at Johannesburg, we find that the narrow stopes, 4 to 6 feet wide, of the 'banket' lodes are contrasted with the cavernous openings made in the Alaska Treadwell mine and its neighbours on Douglas Island. In the latter the average depth of hole ranges from 5 to 8 feet; in the former, 4 to 7 feet. The length of hole drilled per shift is 23 inches on the Rand and 32 in Alaska. But this comparison is less eloquent than that giving the tons broken per shift per machine; in Alaska it is 33½; on the Rand only 10; thus the greater width of the orebody enables the drill to be used so advantageously in Alaska that 3½ times more ore is broken than in the South African mines selected for this comparison. Similarly, dynamite is employed to a greater advantage, 1·13 pounds being required per ton of ore on the Rand and only 0·41 pounds at Treadwell. These factors affect expenses to such an extent that the total cost of breaking ore is 18½d. per ton at Treadwell and 4s. 10d. at Johannesburg, the details showing that labour entailed 11·3d.; power, maintenance, and sharpening, 3·6d.; and explosives 3·35d. per ton in Alaska, as compared, respectively, with 22·8d., 21d., and 14·45d. on the Rand. This does not mean that the use of machine-drills on the Rand is prohibitive, but it does draw attention to the main obstacles in the way of economy. Competitions between drill-makers add to the interest of life and offer food for controversy, but it is doubtful if they achieve their purpose, which is to ascertain the machine best adapted to local conditions. These are not reproduced in the trials, for exhibition work on the surface is quite unlike stoping; moreover, the skilled operatives engaged in the competitions do not resemble the miners to whom the machines are consigned in the underground workings. If the managers instruct the shift-bosses to take more trouble in teaching the natives how to use the drills properly and if a premium could be paid for skilful handling, an increase of efficiency might result. Another point worth mentioning is that inefficiency is often due in mines everywhere to the low pressure of air delivered at the drill; this may be due to leakages, or to poor compression; it requires closer attention than is customary.

Professional Directory.

The question of the propriety of placing a card in a professional directory has been ventilated recently as part of the general subject of professional advertising. This is a matter on which a large number of engineers have already expressed their opinion in a practical way, by utilising a form of publicity considered to be as useful as it is dignified. But it appears that in London a group of men, small in number, but notable in their local influence, have seen fit to question a practice now well established in Canada, Australia, and the United States. Two arguments are made: that it is not professional to advertise, and that it is not an English custom, even if Americans see fit to do so. We yield to none in solicitude for the dignity of the profession and we agree that the ordinary forms of display advertising should be deprecated, especially such as constitute bids for employment by means of exaggerated claims for skill. No reputable mining periodical permits such eccentricities in its professional directory, which is mainly a convenient list of the active members of the profession; it partakes no more of the character of objectionable notoriety than a telephone or a postal directory, and assuredly is more seemly than the large brass plates placed conspicuously at the entrance of office buildings. There is advertising, and advertising. Some of the individuals who are prepared to criticise their professional brethren in this matter are themselves the most persistent advertisers, using every opportunity to get undue prominence; others, whose conduct is above reproach, yet get all the advertising they need, and more, by means of public acts, company meetings, and other proceedings in which they play a distinguished part. Let us get rid of cant and be outspoken. We are told that doctors do not advertise. The reason is obvious: their practice is local, it is largely restricted to a neighbourhood; they get all they want in the way of publicity by having their names in the directories, postal and telephone, where they appear also in a segregated form, all the doctors being grouped for the convenience of possible patients. But to compare doctors and mining engineers is not reasonable; the doctor has a parish for his life-work, the engineer has the world. Owing to the exigencies of mining, it is found that engineers and metallurgists change their addresses so often that no annual directory can be correct or up-to-date. A professional directory that can be corrected every week or every month offers advantages, the usefulness of which has been tested for at least twenty years.

The times change and we with them; blind prejudice should not block the way. With characteristic independence the American mining engineer has seen fit to adopt the custom of the professional directory, simply because he found it did him a service without injuring his sense of what was befitting the dignity of the profession. In Canada and in Australia also this practice is in vogue among men of the highest standing. Is it for a coterie of Englishmen to dictate to the 25,000 mining engineers and metallurgists in the English-speaking countries as to what is "good form" and what is "bad form"? We think not. It is time to drop this distinction between American and English engineers; there are efficient engineers and inefficient engineers, there are those that are honest and those that are dishonest, but there are no English and American engineers in any invidious meaning of those national adjectives. The profession of mining is neither insular nor provincial, it is cosmopolitan. Englishmen are employed by Americans, and Americans by Englishmen; the only test is worth, not accent or the cut of a man's clothes. It is high time to cease assumptions of superiority over the other peoples speaking the English language; such top-lofty pretensions are responsible for much unnecessary irritation in the past, they must be dropped if we are to avoid trouble in the future. Cant is not argument, and prejudice is not morality. A wide outlook and an open mind must be brought to bear upon matters affecting our profession.

It is a fact that the majority of the active practitioners, in mining and metallurgy, in the United States, Canada, and Australia use the professional directory as a convenient method of notifying their friends where they are to be found. Furthermore, even those who are not engaged in general practice will place their cards in such directories simply to give financial and moral support to mining papers that are doing useful work. This expression of goodwill is of inestimable value to the editors and publishers of such papers, because such support from the rank and file of the profession places these periodicals above the need of asking for the patronage of promoters, stock-jobbers, company directors, and others wishing to exercise improper influence. If many English mining engineers have not cared to place their cards in the directories of English mining papers, it is because no mining periodical of high character has been available in London, nor has any available paper segregated such cards from the ordinary forms of advertising. Mining engineers in the United States and in Canada enjoy the advantage of technical papers of the highest character, deserving the support of professional men. The directories of such papers serve a distinctly useful purpose and accentuate the goodwill upon which successful technical journalism is based. We hope to win similar support, and we appeal to the rank and file of the profession in every part of the world.

Smelter Fume in California.

The smelter of the Selby Smelting & Lead Company is situated across the bay 30 miles northeast of San Francisco. It was founded in 1868 by Thomas Selby and was absorbed by the Guggenheims in 1905, becoming a subsidiary of the American Smelting & Refining Company. The importance of the works may be gauged by the fact that they refine five million pounds worth of gold and from twelve to fifteen million ounces of silver per annum. The chief supplies consist of silver-lead concentrate from the Bunker Hill and Sullivan mine, in Idaho, and silicious gold-silver ore from Nevada. Besides producing pig, the works make a specialty of the manufacture of white lead. A complete article on the methods of smelting and production of paint as conducted at this establishment appeared in the *Mining and Scientific Press* of May 9, 1908. For several years the management has been worried by injunctions prompted by their neighbours in Solano county and in the town of Benicia, the citizens of which allege that the air is fouled by unpleasant gases; but these legal proceedings were not started by adventurers who hope to make something out of it, as was the case at Keswick and elsewhere in California. Recognizing that the agitation against them was genuine, if mistaken, the Selby directors have taken unparalleled pains to minimize the nuisance and have adopted all sorts of devices to prevent the escape of sulphurous and lead fumes. Just before the earthquake, in 1906, the erection of a complete system of bag-houses was commenced; at first cotton bags were used, and as they did not prove satisfactory, woollen bags were substituted. Another source of annoyance to the neighbourhood was the sulphurous fume given off by the refinery. The gold and silver bullion is refined by the sulphuric acid process; the metal is placed in large iron pots with sulphuric acid and heated, the silver going into solution and the gold precipitated. The dense fume given off during the boiling was a decided nuisance; thereupon, experiments were made with an electro-static apparatus invented by F. G. Cottrell, of the University of California. This electrical contrivance precipitates the acid fume so that none of it escapes. The only pollution of the air now debitable to the Selby smelter is due to the Ropp roasting-furnaces; no attempt is made to catch the sulphurous fume from these, but it is claimed that the amount of sulphur thus escaping is insignificant, the dilution of the furnace gases with air being copious, so that the emissions from the stack are innocuous. It is claimed that no damage is done to vegetation. This, in general terms, is the position at the present time. Further details are given in the *Mining and Scientific Press* of August 7 by Eugene B. Braden, vice-president of the Selby Company. He states that the most recent objection raised by his neighbours relates to a nauseating smell and has nothing whatever to do with sulphurous acid or lead fume. In order to show that the smelter was not the guilty party, he stopped smelting entirely, but still the objectionable smell pervaded the atmosphere. The Selby Company's investigation into the real cause of the smell has resulted in their saddling the blame upon the Union Oil Company's refinery, a mile distant. It appears that in the manufacture of asphaltum by the distillation of crude oil, certain offensive gases are given off, such as allyl sulphide; these gases are much more persistent and penetrating than sulphurous acid and their odour resembles that of garlic. At the forthcoming further hearing of the suit, the true cause of the nuisance will no doubt be fully explained to the inhabitants of Benicia, and we trust they will then be too reasonable to harass metallurgical operations so necessary to the surrounding mining regions.

The electro-static method of condensing the sulphuric acid given off during the refining process has also been tried on the sulphurous gases coming from the roasting furnaces; but as yet no definite results have been obtained, although success is confidently anticipated. Some people may question the statement that the gases from the roasters have not sufficient content of sulphurous acid to cause a nuisance; in Great Britain, sulphuric acid works are not allowed to give out more than 1½ grains of SO_3 per cubic foot, and the law of 1906 gives power to the inspectors to enforce this limit on smelters, provided the alteration in the plant can be made without great expense. In the Swansea district the blast-furnaces working on copper ores give off 12½ grains of SO_3, and the inspectors are accordingly pressing for an improvement. The roasting of raw ore is always done in furnaces where the sulphurous acid can be recovered, but the roasting of matte gives a gas well within the legal limit.

Undoubtedly the exacting, if not unreasonable, attitude adopted by the rural communities adjoining the smelters in the Western States is traceable to the mistaken policy of the smelting companies, which, as they prospered, and grew to great industrial importance, disregarded the rights of the agricultural and pastoral population. There was no excuse for erecting large smelters in the very midst of the Salt Lake valley, one of the few large productive tracts of land between the Rocky Mountains and the Sierra Nevada; these smelters might just as well have been built in the arid desert that surrounds the old Mormon settlement, for at Salt Lake or near it both coal and ore are lacking, nor are railroad facilities better than they would be at places close to the coal-fields and the metal mines. Even as regards a labour supply, an agricultural community offers no particular advantage, because a large smelting establishment creates its own little town and develops its own tributary settlement. The accent must be placed on the word "large" because small smelters may escape becoming an annoyance, while a large plant on the same site may prove a public nuisance; the effect of fume depends upon the volume of it and the extent to which therefore it becomes diluted as it escapes into the surrounding atmosphere; it depends also upon the direction of the prevailing wind and upon the humidity of the air at different seasons. By stupid disregard of public interests some of the smelting companies aroused bitter resentment among the farmers and cattle owners of the West, provoking litigation and even blackmail, until the smelting industry seemed likely to be outlawed. Many smelting establishments themselves innocent of such criminal carelessness and many smelter managers that had always taken pains to mitigate the injurious effects of their operations were thus made to suffer for the obtuseness of a few corporations that had provoked public condemnation in the manner just related. Feeling ran so high that the Courts were invoked successfully; at San Francisco the erection of a big plant was stopped, in Utah several smelters were forced to close down, in Montana costly litigation followed upon unavailing efforts to settle the claims of the farmers, and elsewhere, in Tennessee, Colorado, and California, the continuance of the metallurgical operations so necessary to the completion of mining was threatened. Then indeed sentiment changed; on the one hand, the smelter people became more respectful of their neighbours and, on the other side, the community began to realise that this hue and cry against smelting was threatening their own commercial welfare; it was realised that public interest required an observance of the unwritten law of the greatest good to the greatest number.

The Price of Copper.

Speculation in copper metal, particularly at New York, and speculation in copper shares, particularly the new issues based upon recently discovered orebodies in Arizona, has given the copper market unusual interest. Moreover, the increasing use of the metal in the arts of civilization has made the consumption of it coincident with modern industrial advancement to such an extent that it now fulfils the function of a trade barometer. Attempts made by metal companies and copper producers in the United States to restrict production by arbitrary methods having proved futile, it is unlikely that any further efforts will be made by combinations of capitalists to create artificial prices. The memory of several fiascos in the past still lives as a warning to irresponsible manipulators. It is recognised now that the price of copper is obedient to the laws of supply and demand in their worldwide application, the interchange between local markets being so easy as to yield a price applicable to all of them. The recognition of the fact that production and consumption, not London and Paris, not Rio Tinto and Amalgamated, decide the ruling price of copper has led to a clarification of ideas. This has been expressed in the formation of the Copper Producers' Association of New York, the purpose of which is to dissipate mystery by affording the strong light of trustworthy statistics. Thanks to this Association, we now obtain every month a valuable statement of the deliveries, accumulation and absorption of copper in America. These figures, together with the European statistics of the Metallgesellschaft of Frankfurt and the metal merchants of London yield sufficient data to permit of a reliable approximation of the copper position from time to time. American supplies are estimated by adding production to imports; the domestic consumption is obtained by taking the difference between supplies and exports, and then adding to this the loss or gain in stocks.

The position in America may be summarized by stating that for the first seven months of this year, the total supplies, including imports, are 358,856 tons, or an average of 51,265 tons per month. But during the last three months of this period the rate has increased to 53,000 tons. Assuming that this rate of supply is maintained for the remainder of the year, then the supplies anticipated will be 265,000 tons, so that the total for the year will be 623,856 tons. These figures must be interpreted in terms of the consumption. We find that domestic consumption in the United States has been 175,681 during the first seven months of 1909; that is, 25,000 tons per month. But the consumption for the last three months averaged 28,000 tons, and that of August was 33,700 tons. Thus an increasing consumption is manifest; moreover, there is reason to anticipate that this increase will be accelerated during the remainder of the year. If the average consumption for the remaining months should be at the rate of 32,000 tons, which is not optimistic, then the consumption for that period will be 160,000 tons, so that the total consumption for 1909 will be 337,681 tons. This would be 18,000 tons more than during the boom of the year 1906.

Exports from America for the first seven months of 1909 have amounted to 180,565 tons, or an average of 25,795 tons per month. The result of these large exports have been to increase European stocks by 21,000 tons; in other words, the quantity of copper exported has exceeded the needs of Europe by 3,000 tons per month. If the exports for the remainder of the year should average 22,800 tons, which is the amount apparently sufficient for European requirements, then the total exports for 1909 would be 294,565 tons. This tonnage added to the anticipated domestic consumption of 335,681 tons, would give a total of 630,856 tons, as against estimated supplies of 623,856 tons. Thus a small margin is provided for shrinkage in

AMERICAN STATISTICS

	Production.	Imports.	Supplies.	Exports.	Stocks.	Domestic Consumption.
January ...	40,360	9,700	50,060	18,500	64,820	21,840
February ...	34,800	11,500	46,300	13,400	77,820	19,900
March ...	39,200	13,000	52,200	20,800	81,830	27,490
April ...	36,700	14,000	50,700	28,080	82,240	22,210
May ...	40,790	12,500	53,290	31,400	75,900	25,040
June			52,040	33,339	69,100	25,501
July			54,366	35,046	54,720	33,700

STOCKS OF COPPER

	Europe.	U.S.	Total.
End of 1908 ...	55,677	55,100	110,877
January, 1909 ...	52,935	64,820	117,755
February ...	52,295	77,820	130,115
March ...	52,295	81,830	133,184
April ...	50,918	82,240	133,158
May ...	56,854	75,900	132,754
June ...	67,379	69,100	136,479
July ...	76,559	54,720	131,279

consumption or increase in production, and there should be no increase in either European or American stocks during the latter part of the year. From this we deduce the conclusion that there is no basis for anticipating any important change in the price of copper in the near future.

At the present time the opposing factors influencing the price of copper are nearly balanced; the difference between over-supply and under-supply is only a matter of about 20,000 tons; that is, a shrinkage in supplies of 40,000 tons would prove a serious shortage. More than 40,000 tons of copper is being produced at a cost exceeding 13 cents per pound, or £60 per ton, of refined metal, therefore a slight drop would suffice to check the yield from mines producing copper at a price near to the present market quotation. It becomes more important to know how much is being produced at a high cost in the hope of betterment in price than to ascertain how much is being obtained at the minimum cost. The market will remain steady until the production of cheap copper displaces the expensive copper; or in other words, until the increasing production from the new mines in Nevada, Utah, and Arizona, displaces the metal extracted in the older mines of Montana, Sonora, and British Columbia. Mines in process of equipment, such as Miami, Ray, Tanganyika, and their neighbours, will give an increase of copper production equal to 100,000 tons per annum, but this metal will not be in the market for 12 to 24 months. This copper will be produced for 9 cents per pound or £42 per ton, or even cheaper. If, in the meantime, there is no increase in the world's consumption, a number of large mines producing copper at 12½ cents or more per pound or above £58 per ton will be forced to suspend by any depression in the market price. It becomes necessary to learn what proportion of the total output is cheap copper, that is, metal produced at a cost well below the present price. Of the total copper mined in America, about 13 per cent. is marketed at a cost higher than 12½ cents per pound, and 38 per cent. is produced for less than 9 cents per pound. Thirteen per cent. of the American production is 61,000 tons. The increase in the world's consumption is proceeding at the rate of about 7% over each previous year, so that the normal increase for 1910 will be only 40,000 tons, as against a probable increase in production during 1909 of about 70,000 tons. Undoubtedly the present abnormal consumption is due to the stimulation that follows a period of depression; it cannot last.

In 1906 the domestic consumption in America was 316,000 tons; this was a boom period; then came the panic of 1907. Some of the increased consumption of 1909 is undoubtedly due to a replenishing of supplies required for betterments and equipments that were stopped in 1907 and 1908. German consumption of copper ran ahead for the first quarter of this year, but slackened later: but in that country, according to the latest trade returns, the bottom of industrial depression appears to have been reached. In France and England there is an expansion of industry entailing an increased consumption of copper; particularly during the last three months. In America the trade revival is unmistakeable, and gives promise of growing into one of those periodical booms that mark the crest of each wave of advancement.

Thus while existing conditions make for stability, there are factors in process of development that ensure a large increase in the production of copper at a cost below the present market price. Production appears destined fully to keep pace with any anticipated consumption; therefore, there is no reason to expect an increase in the price of copper, although there is no immediate fear of a further decline.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Introductory.—The contributor of mining notes from the Transvaal, or more particularly the Witwatersrand, finds himself in an exceptionally fortunate position. In few great mining centres of the world is information given more willingly and abundantly; the free interchange of ideas and experiences, so marked a feature of Rand technical life, has long been rightly held to be one of the most effective means of lubricating the wheels of our industrial machinery. There are several societies of high standing and large membership domiciled in Johannesburg; these serve the needs of the chemists, metallurgists, miners, geologists, mechanical engineers, and other branches of the mining profession. Problems of current concern are ventilated before these organisations, almost as a matter of course. They are essentially 'practical' institutions; otherwise they would soon languish for want of support amid an environment so materialistic. At the meetings, the university graduate and the working miner are encouraged to feel themselves equally at home. Thus do the different schools of thought, commonly classified into the theoretical and the practical, unite in their common effort to attain the highest efficiency in all departments. The financial heads of the Rand mining groups, controlling an industry so happily free from market competition, are similarly disposed to impart their news of development and publicly to propound their schemes of expansion, while they unreservedly encourage their technical employees of all ranks to carry their ideas and inventions into the field of open discussion and scrutiny. The Government, Chamber of Mines, and local Press add their substantial quota to our knowledge of general progress. Thus do the responsibilities of the correspondent lie principally in the efficiency of his reduction; the material is abundant; it is the close concentration of the useful product that calls for his ingenuity, while the tailing must be allowed to flow away unheeded. If the residue should assay high, excuse must be found in the limited capacity of the 'plant' and the excessive tonnage available for treatment.

Head-frame of the South Rand Shaft, Crown Mines Ltd.

Purifying Mine Air.—W. Cullen, manager of the Modderfontein Explosives Factory, is not a man who jumps hastily to conclusions or confuses experimental indications with assured facts. His announcement, therefore, that he and his assistants have produced a 'modified explosive,' as powerful as blasting gelatine and no more costly, which gives off no CO in detonation, may be accepted with unreserved satisfaction. Mr. Cullen has been experimenting for 3½ years to this end. With ordinary gelatine, he found that the ratio of CO to CO_2 was about 1 : 6 or 1 : 9. By stripping off the cartridge paper, the ratio was reduced to 1 : 18, but this offered no practical solution. By introducing more potential oxygen, the ratio was lowered to 1 : 16·7 and without the wrappers to 1 : 26·2. He has now adjusted the excess of oxygen so that the only CO evolved is that given off by the fuse prior to explosion. The 'modified explosive' has not yet been licensed and is in the hands of the Government Inspector, so that full details of composition are unlikely to be published for some time, if at all. It is stated to have been tried with good practical results in the mines and to have won the approval of the working miners.

Development Systems.—The announcement is made by the General Mining and Finance Corporation that in future the scheme of developing the Rand Collieries gold mine will be altered, and that, instead of following the ore, the drifts are to be run on lines in the foot-wall. They will be carried straight, so as to facilitate future tramming operations and reduce development costs. This principle has been adopted in other mines and will be more widely followed in the future, where systems of electric or rope haulage are employed. It is open to question, however, whether the Rand Collieries is yet ripe for the introduction of such a policy. The knowledge of the lode-structure provided by the cross-cut raises thrown out at intervals along the drift is comparatively unreliable, and it is often advisable for companies such as this, doing exploratory work in a little known part of the Rand, to sacrifice future economy in order to gain the fullest knowledge of their 'reef' and its gold contents. Straight driving, mechanical transportation along the levels, and long backs are a combination of factors, making for economy, to which the managers have long been tending.

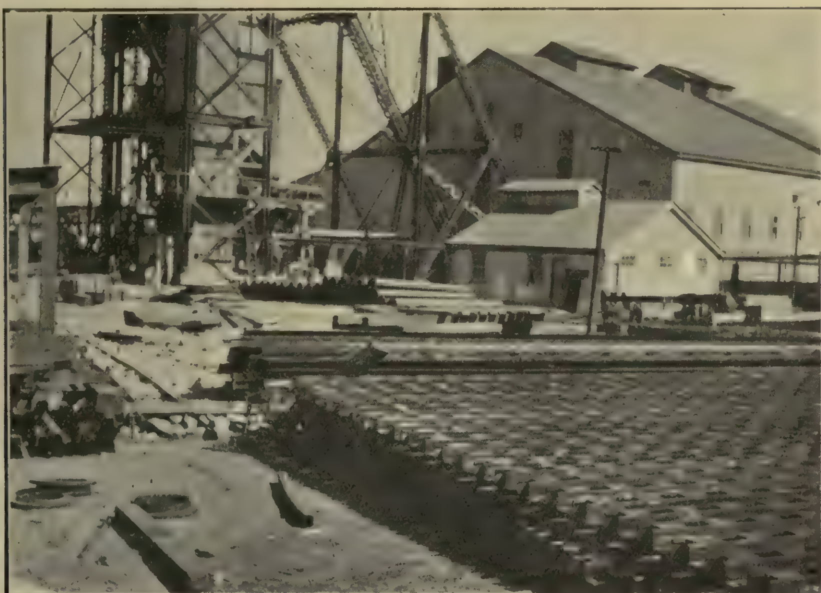
Old Mine Resuscitated.—The successful revival of the York mine and the big tonnages being drawn from the old stopes of the outcrop mines such as the Crown Reef, Robinson, and Ferreira, have led many to believe that there is still life in the 'worked out' areas of the Rand. However profitable the process of picking and fossicking may have been, it must be acknowledged that the re-equipment of the old Stanhope mine is a daring and obviously justifiable enterprise. The Stanhope, a little mine of 6½ claims adjoining the Geldenhuis Estate, produced £495,296 from 239,102 tons up to the War and was worked for a year or two after. It was closed down, finally, it was thought, in 1906. A few weeks ago, the mine was triumphantly re-floated and a 10-stamp mill is now in course of erection. The probabilities are that this mill can be kept running for about a year or two on pillars and other scraps, but the prospects of success, that is, of a return of capital and interest commensurate with the risk, are apparently small. This pessimistic view is taken in spite of the many discoveries of foot-wall and hanging bands of reef that were missed in the old stopes of the outcrop mines of this district.

Rand Deep Levels.—The report of the City Deep for the three months to June 30 is of wider interest than the general run of quarterlies. It provides further evidence of the existence of a rich zone at great depth. The company has already developed 1,200,000 tons of an average value of 9·1 dwt., and the unpayable rock only amounts to 120,000 tons —mostly South Reef. The most striking and convincing point made in the report is the fact that the connecting level between the two shafts (3,000 ft. vertical depth) is over 6,000 ft. from end to end and has not opened up any unpayable ore. The prospects of persistent grade on the dip are also good, as shown by the analysis of average grade of each successive level. With ore reserves so large the anxiety of shareholders to see an early start of milling operations, on a scale befitting the claim-area, is readily understood. The arrangements made with the Victoria Falls & Transvaal Power Co. to expedite the provision of electric power are, consequently, a source of satisfaction and suggest that well before the end of next year this great mine will be producing on a large scale.

The New Rand.—The apparent ease with which A. R. Sawyer is able to raise fresh capital for the continuance of drilling operations in the Orange River Colony, while the promoters of Main Reef 'extension' propositions nearer the Rand have difficulty in getting money to prove the value of outcrop indications, is often mentioned with envious surprise. The operations of the New Rand venture, which seeks the southern rim of the Rand basin below the coal measures, are most speculative, but the chances are nevertheless better than many of the "good gambles" placed before the public. Even if the new boreholes strike 'reef,' great ambiguity must prevail as to the significance of the results. There are assuredly many banket' beds in the hidden Witwatersrand, formation between the Nigel-Greylingstad area and Venterskroon. The intersection of one of these 'reefs' and the return of a good assay would still leave us far from the development of the 'New Rand.' This fact, however, is no reason why the plucky speculators acting under Mr. Sawyer's advice should be discouraged. Being after a big stake, they are presumably prepared for all contingencies.

East Rand Developments.—The Far East Rand being the district that offers the widest field for the opening up of new mines at 'moderate' depth (as properties of 3,000 to 4,000 ft. are now regarded), all items of news emanating therefrom are received with avidity. There has been some uneasiness of late because the Van Ryn Deep has been slow or reticent in announcing the full results of the strike made in its shaft. The rumoured disclosures have been particularly mystifying and whether the Main Reef series or merely some overlying stringers have been cut cannot be safely surmised. That the property is one of payability—even under the burden of a huge capital—is likely enough, in view of its central position in the midst of the Apex, Kleinfontein, Van Ryn, New Modderfontein and Brakpan mines. Sinking in the Van Ryn Deep is impeded by a heavy influx of water.

Brakpan Mines.—Since the striking of a wide body of high-grade ore in the No. 2 shaft, very little has been heard of development results in these mines until the issue of the quarterly report to June 30. The heart of this statement is the estimate of ore reserves; this is highly satisfactory. The figures are: Payable ore, 448,849 tons at 6·4 dwt.; unpayable, 125,046 tons at 1·7 dwt.; total, 573,895 tons at 5·4 dwt. The report boldly deduces from these figures the probable yield and states that with 12½% sorting of waste, and a 93% extraction, the recovery should be 29s. per ton. This appears, of course, a simple calculation, but the true boldness lies in the fact that the estimate of 29s. will stick in the minds of shareholders and leaves little loophole for amendment for (1) discrepancy expressed by the 'assay-plan factor' and on the difference, generally on the wrong side, between actual and estimated yield, (2) the watering down of stope-values by the rock drawn from development faces, (3) the possible increase of stoping width over that estimated, and (4) the inclusion of some ore from the unpayable reserves. On the other hand, there should be a good chance of the sorting percentage being increased over 12½. It is noteworthy that the estimated yield of 29s. is about the same as that to be calculated from the last published estimate of the New Modderfontein. It is understood



Slotted steel girders for the Turf Shaft (4066 ft. deep).

that the equipment of the Brakpan will be on a large scale—up to 60,000 tons per month. Possibly labour difficulties, if long prevalent, will prompt the directors to sanction the erection of an initial plant of more modest capacity.

Gold Thefts. — The question of gold thieving — which, on the Rand, can only take place in reduction works — has lately been agitating the minds of many directors. The policy of constructing separate almagamating-rooms and of searching the men at the close of the shift are urged as the best precautions. For several reasons, the former provision has commended itself to local engineers, but the latter is more a question of social politics into which technical men do not care to enter. To strike at the root of the evil, it would probably be best to investigate more closely the means employed for the disposal of the stolen products. This was certainly the experience at Kalgoorlie in 1906. The arrests made in connection with the trade are anything but frequent and the few convictions only fall upon the heads of the underlings. The magnitude of the I.G.B. traffic can readily be exaggerated, but immunity from effective restriction is a reasonable basis for the present mild 'agitation.'

A New Gold Producer.—The stretch of Main Reef in the Maraisburg-Florida district, which was the one great gap in the long line of active companies for so long after the war, is rapidly developing into a centre of exceptionally interesting developments. Soon the Vogelstruis Consolidated Deep will commence milling with its new 40-stamp battery. In accordance with modern ideas, the stamps are of the heavy type (1750 lb.). The neighbouring Bantjes Consolidated has decided to increase its mill, in view of satisfactory developments.

Tin-Mining Progress.—The tin mines of the Transvaal have been seriously hampered of late by the abnormal epidemic of malaria that has scourged the bush district, between Pietersburg and Pretoria. White men and natives have been stricken in hundreds, and the tin-mining regions have been most severely afflicted. Nevertheless the output is increasing. The value of the country's yield during the twelve months to June 30, 1909, was £153,845, as compared with £81,677 for the previous year.

New Rietfontein.—The collapse in the monthly profits of the New Rietfontein has not occasioned as much comment as its magnitude warrants. Last year, the mine was recording a margin of £15,000 per month or more between costs and yield, yet the declaration for May last was £4,384 and for June only £2,889. Such fluctuations are not characteristic of Rand mines and it must always be understood that though on the Witwatersrand, the Rietfontein is not on the Main Reef horizon. Its orebodies, though conglomerate, are very narrow and generally very rich, but far more treacherous than the Main Reef series to the south. Regulation of grade is a most difficult undertaking.

Diamond Mining.—The Premier Diamond Mining Co. continues to treat enormous quantities of blue ground, but diamond mining generally is quiet. Little speculation is being attempted by prospecting syndicates, fortunately for the public. During the half-year to June 30, 1909, there were 3,689,469 loads washed for a yield of 926,738 carats, valued at £580,807. These figures show a decrease of 169,000 loads and 76,000 carats as compared with the previous half-year. The value is officially declared at only 12s. 6d. per carat. If South African diamond-mining may be considered to have been "marking time," the market appears to be still in the rear.

MEXICO.

Political Outlook. — The rioting in Guadalajara during July was considerably exaggerated by the foreign daily Press; unquestionably, there is a strong undercurrent of feeling, especially among the lower classes, regarding the nomination of the next Vice-President and the election that takes place next year. The mixture of a little *pulque* with hot blood, added to speech-making and electioneering propaganda, caused some stone-throwing and window-smashing, but the trouble was soon over and did not amount to more than an average election skirmish. The two prospective candidates were Ramon Coral, who may be termed the Diaz nominee, and General Bernardo Reyes, the popular candidate; there is also a so-called Democratic party, which has not yet named a candidate; General Reyes, however, has publicly declared that he will not be a candidate; and it seems probable, therefore, that the re-electionist party supporting the Presidential candidate, will have a clear field.

The New Mining Law.—For the last three years the question of a new mining law has been under consideration; a project was drawn up by the Ministry of Public Works and presented in the form of a Bill to the Mexican Congress during the last session; after much discussion and some modification, it was transmitted in its present form to the Senate, but, owing to delays, it will not be brought up for discussion until the next session. It is almost certain that the Senate will make important modifications, and it is therefore too early to give definite information regarding the final form of the new law. The date on which it will take effect will be January 1, 1910, provided that no further delays occur. The Bill in its present state contains nine main divisions, consisting of 153 articles and various sub-clauses, besides nine transitory articles. There are no radical changes from the old law; mineral wealth is still considered as a product of Nature and the property of the Nation, whether situated on public or private lands, and can be acquired by any one who discovers a mine, by the usual process of 'denouncement.' Title is eventually granted by the Ministry of Public Works and is held by the payment of annual taxes. Foreigners and foreign corporations can acquire title either by denouncement or purchase of existing rights, and are subject to the same laws as natives throughout the Republic, with the exception of a zone of 80 kilometres on the frontier of any other country. To obtain title within this zone, foreign interests must obtain special permission from the Government.

The spirit of the objectionable clause No. 44 (which was withdrawn) in the mining law has cropped up in a new way: Formerly when concessions were granted, the possessive clause read that "the concession was granted to the individual named or to *the company* which he might organize." It is to be noted that nearly all of the concessions now granted, and published in the *Diaro Official* have the possessive clause worded: "para por si o por medio de la compania Mexicana que al efecto organice, conforme a las leyes de la Republica," which means that the concession is granted for the individual use of the concessionaire or the *Mexican* company that may be organized for the purpose, in accord with the laws of the Republic. There is also a clause expressly stipulating that the concession cannot be passed to a foreign corporation for any reason whatsoever. A letter was recently sent by the Secretary of the Treasury to the board of directors of the national railroads, requesting that natives be given the preference in promotion and employment whenever possible, and also criticising the board for not having 'Mexicanized' the great body of the railroad employees more rapidly; this letter has been the subject of much comment in both the Spanish and English local Press and also among individuals. A great many foreigners have taken it as indicating a willingness on the part of the Government to pander to the anti-foreign agitation, which exists in certain

State of Jalisco, Mexico.

districts. It is to be regretted that the change from foreign to Mexican employees (which is only natural) could not have been made gradually and without so much publicity, which only raises issues that are better left dormant.

Railroad Development.—The extension of old lines, the purchase and consolidation of small local lines by the larger and more powerful companies, together with the grant of numerous concessions, and the heavy investment of capital, prove the confidence of the capitalist in the stability of the Mexican Government, and in the prospects for the progress of the country. The incorporation of the Harriman Mexican interests, under the title of the Southern Pacific of Mexico, with a capital of $75,000,000, is the most important event in recent railroad finance. This company will control all the Harriman lines now built or building in Mexico, including the Sonora Railroad, the Cananea, Yaqui River, & Pacific Railroad, and the Southern Pacific extension south, along the Pacific coast, through Mazatlan to the terminus at Guadalajara. The construction of this last line already reaches well into the Territory of Tepic, and is stimulating mining development in that region and in the northern part of Jalisco. E. H. Harriman is president of the new company and Epes Randolph is manager, with R. H. Ingram as head of the operating department.

The Kansas City, Mexico, & Orient Railroad has increased its capital stock from $25,000,000 to $75,000,000 and is actively engaged in pushing the extension of the lines into northern Mexico. This railroad will run through Chihuahua and Sinaloa, having its terminus at Topolobampo on the Gulf of California, and will open up a rich and, at present, inaccessible mineral region. There seems to be every probability of a new line being constructed from Guadalajara to the Pacific coast at Chamela. It will start from Ameca and run through the important mining districts of Ayutla and Autlan, and terminate on the coast about a hundred kilometres north of the port of Manzanillo. The Mexican Southern, which connects the cities of Puebla and Oaxaca, has been practically absorbed by the merger system of Mexico. The Mexican Railway (Vera Cruz) was trying to secure a lease of the Southern for the remaining term of its concession, but the Interoceanic got ahead and secured the lease first. The Interoceanic is controlled by the National, so that, in effect, the Mexican Southern now forms part of the merger. A concession has just been granted for a new line from Oaxaca to the Pacific coast with extensions to Salina Cruz, and westward to Acapulco and Manzanillo; this project is controlled by Utah capital.

The Southern Pacific has commenced construction work from Tequila, State of Jalisco, northwards, and will consequently soon tap the important mining districts of Hostotipaquillo. The roadbed is completed for 20 miles up to Quemada and it is expected that the line will be in operation by October 1.

Hydro - Electric Power - Plants. — A merger has been made of the various light and power interests in the State of Jalisco with the 'Compania de Tranvias Luz Y Fuerza de Guadalajara,' which is controlled by domestic capital. This company is constructing an important power-plant on the Santiago river; the immediate capacity is to be 30,000 h.p. and the ultimate capacity 60,000 h.p. The distribution of power from this plant will tend to stimulate mining in the districts of Etzatlan and Hostotipaquillo, and it is expected that about 15,000 h.p. will be taken by the mines in these districts. The company also owns an important concession for irrigation in the vicinity of Lake Chapala, and a considerable amount of power will be required for pumping the water from the Lake to the distributing canals.

SAN FRANCISCO.

The Silver Question.—Persistent efforts are being made to revive the silver question, not only in its monetary relations, but as a commercial matter of large importance. The silver craze was so unreasonable a malady in its acute Bryanesque phases some years ago that when one mentions the subject approvingly by any of its old familiar names, the business man of to-day is ready to suggest an examination by alienists. But with more than half the world using silver as currency, the problem cannot be ruled out of the economic forum. Mr. Moreton Frewen recently pointed out that Great Britain has in effect a bi-metallic system in operation, through the use of silver in India and gold at home, and that this clever arrangement is the life of trade. His words, which have attracted much attention, are: "Great Britain was, and to-day is, the only free gold market in the world—the only country that pays gold on demand. That other vast annex of the British Empire, India, the 'sink of silver,' had a single silver currency, while France, with mints open to receive impartially either gold or silver (her ratio being 1 to 15½), had for long acted as the world money-changer. This accidental structure, for apparently it was quite accidental, this exchange tripod, each leg as necessary as its fellow, secured stability of exchange between Asia and South America on the one hand and Europe and North America on the other. I have come to see that England's so-called monometallism, her gold currency and free-gold market in the West, her 'silver sink' in the East, was quite as essential to the perfect exchange mechanism as was the free mintage of both the metals by France. We may as well endeavour to decide which is more important in an engine, the fly-wheel or the piston." He also shows how the demand for silver fluctuates with the rainfall in the Orient, and how these affect the swing of the financial pendulum in the West. From Nevada has recently come a suggestion by J. B. Giffen to place an import duty of $1 per ounce on silver, coupled with a return to the free coinage of that metal, while still collecting duties in gold. The demonetization of silver, as we now know, was an accident of typography, an error in printing a Bill, uncaught until passed and signed. The suggestion of a return to free coinage of silver without an international agreement on an exchange rate is essentially faulty. It would send gold to a premium inevitably, despite the duty. The position of silver is certainly anomalous; it is not a simple commodity, for money is a token, and token-metal possesses a different status, in the last analysis, from metal that is intended for consumption in commerce. It seems to be quite impossible to remain lucid when discussing bi-metallism. The principle attacked the country like an epidemic more than a decade ago, and the antiseptic of an overwhelming electoral defeat and a subsequent epoch of world-wide prosperity, despite the "lack of facilities" of a double standard, had supposedly terminated the craze. Its recrudescence now may be symptomatic of the financial straits of the past two years, which have brought many silver-producers to shipwreck. For good or ill the subject is again assuming importance, and is listed for discussion at the forthcoming meeting of the American Mining Congress at Goldfield, Nevada, in September. The excuse offered is the need of a lower rate of exchange to hold Oriental trade. The silver question never stands alone. It attached itself to agricultural depression in 1896; now it is proposed as a help to win Oriental trade against the disabilities of throttling maritime statutes.

Smelter Fume.—The most serious difficulty confronting the smelting industry in the West to-day is the suppression of fume. Almost every centre where lead and copper are treated has had its struggle with agriculturists or with municipalities. The Selby Smelting & Lead Co., which operates an important plant on an arm of San Francisco bay, has long experienced trouble with the town of Benicia. An injunction was granted ordering the suspension of smelting. The company had installed a bag-house for elimination of the more objectionable substances in the fume coming from the roasting furnaces, and had applied a new electrical system invented by F. G. Cottrell for condensing the sulphuric anhydride from the bullion refinery. Being convinced that the fume complained of by the people at Benicia was not due to the smelting operations, but to the sulphuretted hydrogen, allyl sulphide, and other nauseous gases evolved in the refining of crude petroleum at a neighbouring plant, the Selby

Bay of San Francisco
Showing position of the Selby Smelter.

company continued to operate in defiance of the injunction, hoping thereby to force a speedy decision. The case is now in court, and an important decision is soon expected. The peculiar interest of this case lies in the fact that damages are not alleged. In the famous injunctions against the Washoe smelter in Montana, the plants of the American Smelting & Refining Co., and the United States Smelting, Refining & Mining Co., near Murray, Utah, relief was asked on account of damage to crops and livestock. Judge Hunt, of Montana, affirmed the principle of the greatest good to the greatest number, and the preponderating importance of the capital invested, in his decision favouring the Anaconda Copper Co. The Arizona court has recently affirmed an opposite principle in making permanent an injunction against the Arizona Copper Co. at Morenci, which had been sought by an individual farmer as a relief from damage due to slime issuing from that company's mill. The two attitudes are diametrically opposed, one exalting the right of the individual, the other sinking that right in the good of the community. Both decisions were handed down by Federal courts. The Selby case comes before a California State court, which will be disposed to weigh carefully the relative importance of one town against the welfare of an industry that attracts to the metropolis of the State $25,000,000 worth of gold, and which pays in wages a sum exceeding half a million dollars per annum. Protests have been renewed against smelter fume by the farmers around Kennett, California, where are situated the Balaklala and Coram smelters. The Mountain Copper Co. waged a notable fight over this question at Keswick, in the same locality, some years ago, and while it won on its main contentions, for the sake of peace it moved its smelter to Point Lewis, on San Francisco Bay. The injunction granted some two years ago at the instance of the farmers against the United States company in Utah, and later modified so as to permit of their running their lead furnaces, has now been further modified so as to allow the copper furnaces to resume. In this case the right to run was obtained upon showing the Court that the bag-houses, which had been installed, corrected the evils against which complaint had been made.

Smelting Companies. — The International Smelting Co. has become a great factor in the copper industry, and its influence seems to have been steadying. For one thing it has put an end to calling the American Smelting & Refining Co. the 'smelter trust.' The advent of the new corporation means competition that seems to be genuine. Whether it will lead to reduction of smelting charges remains to be seen. The efforts of small independent smelters to offer relief have not been successful; two such enterprises, at Ponderay, Idaho, and at Tintic, Utah, have met disaster within a year, the really important shippers continuing to patronize the large smelting concerns. The fact that most of these productive mines were under contract is only part of the explanation; those who were free to contract preferred to deal with companies that could and would effect prompt settlement, and which could continue receiving ore in the future without cessation. The International Smelting Co. is building a large smelter in Pine canyon, Tooele county, Utah, under the direction of E. P. Mathewson, who is also manager of the great Washoe smelter at Anaconda, Montana. This plant will primarily treat the ores of the Utah Consolidated Mining Co., which operates the famous Highland Boy mine, but will also be a competitor for custom ores. The International, which owns the Raritan refinery in New Jersey, is also acquiring properties in Arizona, and it is supposed virtually to control the Cananea Consolidated Copper Co. with its allied railroad enterprise, which will soon afford connection across the Sierra Madre with the Chihuahua Pacific.

DENVER.

Congresses and Conventions are a common feature of American life and the summer is the season devoted to them. This year the West is especially favoured. In addition to meetings of the Irrigation Congress at Spokane, the Trans-Mississippi Commercial Congress at Denver, and the American Mining Congress at Goldfield, all of which are usual, the British Association for the Advancement of Science is paying a visit to Winnipeg, Manitoba, and the American Institute of Mining Engineers is in September and October to hold sessions at Spokane, Seattle, and Tacoma, in Washington, and at Salt Lake, Utah. The British Association has been generously welcomed and the meetings and excursions have been attended by many scientists from south of the international boundary. Notable preparations are being made for entertaining the American Institute of Mining Engineers on its Western trip. The party will travel by special train and will visit Butte, the d'Alene, and other points *en route*. As this is the first 'far western' meeting since 1899, when California entertained the Institute, there will be much of interest to see. Much regret is being expressed that Nevada, especially the new camps developed since the former meeting, are not included in the itinerary, but these important mining centres will have an opportunity to exercise their hospitality in connection with the meeting of the American Mining Congress at Goldfield, September 26 to October 1. Because of the close relation between the mining industry and the public lands, not only the technical and scientific meetings but the commercial gatherings as well, hold much of interest for mining men. The Irrigation and Trans-Mississippi Congresses are great organisations for formulating public opinion and in the present state of flux their debates and resolutions regarding Governmental activities and public lands excite general interest. At Spokane lately, and later at Denver the sharpest differences of opinion have been brought out with regard to Government withdrawal of public lands, particularly those suitable for water-power sites. On the one hand Gifford Pinchot, head of the Forest Service and the close friend and adviser of ex-President Roosevelt, maintains that R. A. Ballinger, the Secretary of the Interior, is breaking down the Roosevelt policies designed to prevent the monopoly of these lands by private interests. On the other hand Mr. Ballinger and George Otis Smith, the chief of the Geological Survey, who spoke for Mr. Ballinger at Spokane, maintain that the Secretary is merely enforcing the law and refusing to go beyond the legal limits of his authority in making withdrawals; that, in effect, if harm comes, the blame must rest with Congress for not having passed suitable legislation. It is difficult to form a correct judgment of the merits of the case, but the temper of the Irrigation Congress was undoubtedly with Mr. Pinchot and against Mr. Ballinger. This is the more striking since Washington is Mr. Ballinger's home and a State where he has many friends. There is, however, more than a suspicion that in these matters he is not only a strict constructionist but a reactionary, and the decision of W. H. Taft, the President, regarding the point at issue is awaited with much interest as it is felt that it will indicate absolutely whether the 'progressives' or 'reactionaries' are to control through the next four years. The mining laws in America are in many particulars so defective and the relations of mining to the Department of the Interior are so close that the whole controversy is being watched with keen interest.

Conservation of natural resources and problems relating thereto continue to attract much attention. The phosphate deposits in the public lands are being examined in detail by the Geological Survey and Bureau of Soils. Pending further legislation, they have been withdrawn from entry. C. R. Van Hise, president for the University of Wisconsin, has severely attacked J. A. Tawney, chairman of the committee on appropriations in the House of Representatives, for failure to provide funds for the National Conservation Commission established by Mr. Roosevelt and for legislation that forced the abandonment of the Commission. Mr. Tawney in reply points out the practical work now being done by existing governmental agencies, such as the Forest Service, Reclamation Service, Fish Commission, Geological Survey, and others, and then makes a statement that will probably surprise readers in Great Britain more than it has many in America, that such work can only receive limited appropriations because 73% of the National revenue is now devoted to war expenses, including under that head the Army, Navy, and military pensions. Mr. Tawney says that until the engineers and others interested in scientific and investigative work educate the public to a better balance of expenditure this condition is likely to persist and the burden of peaceful expenditure must fall on the individual States.

Tariff changes will be numerous when the new law goes into effect. The general idea seems to be that while reductions have been numerous they will not avail much to lower the high cost of living, which after all, was the real cause for the demand for tariff revision. There have been numerous changes in the metal schedule. The lower duties on iron ore will help the Eastern furnaces; whether the reduced rate on pig iron will affect domestic prices is uncertain. The final effect, also, of the change in the duty on coal is uncertain and seems to create more comment in Canada than here. The duty on zinc ore will practically stop importations and the American buyers in Mexico are arranging to ship to Europe. One minor change will affect directly a British industry. An import duty of $3 per ton has been put on fluorspar. This will probably stop importations, which have come mainly from England, and give the whole Eastern market to the producers in Illinois and Kentucky. Heretofore the Atlantic coast cities used foreign fluorspar, and the trade at Pittsburg—the greatest consuming centre—was divided between the importers and domestic producers. Many other changes are bound to follow from the new law, but not one of them can be as easily foretold. Even before the tariff law was passed industrial conditions were improving rapidly. Strikes and car shortage, the two unmistakeable signs of good times, are heard frequently and with money at low rates another period of business expansion seems assured.

NEW YORK.

The Metal Exchange, which was severely criticised by the commission headed by Horace White and appointed by Governor Hughes to investigate Wall Street methods, has decided to change its way in accordance with those prevailing on the London Metal Exchange. Henceforth the minimum quantity of standard copper in which dealings are permitted must be 25 tons of 2,240 lb. each, and all bids must be made up in multiples of this unit. Commissions are reduced to $1 per ton when trading with the public and to 50 cents per ton when between members of the Exchange. Copper stored in warehouses in New York will be considered good delivery; negotiable receipts at neighbouring refineries will also be deemed good delivery when they include free lighterage to New York.

Unlisted Stocks.— After April 1, 1910, the unlisted department of the Stock Exchange is to be abolished, in accordance with the recommendations of the Investigating Commission. Among these 'unlisted' are Standard Oil, Amalgamated Copper, Utah Copper, and American Smelting. Most of these will seek for entry on the regular list of stocks.

Braden Copper Flotation. — The Guggenheims have invited subscriptions for $4,000,000 6% 10-year convertible bonds of the Braden Copper Mines Co., owning property on the western slope of the Andes in Chile. The mines are reached over 159 miles of rail from Valparaiso, followed by 35 miles of wagon-road. It is proposed to build a railroad paralleling the wagon-road. According to Pope Yeatman, who examined this copper deposit for the Guggenheims, the orebody lies on the periphery of an extinct volcano in brecciated diorite, near its contact with tuff. Exploratory work has proved that the ore surrounding this crater is from 75 to 200 feet wide, averaging over 2½% copper. Development is effected by a series of adits, exposing iron and copper sulphides in an orebody estimated at 1,750,000 tons containing 2·7% copper, besides an even larger tonnage of partly developed ore. A 250-ton concentration mill is at work and a much larger plant, to treat 2,000 tons per diem, is to be built forthwith. When the new mill becomes available it is expected to deliver refined copper at London for less than eight cents per pound.

Sifted Gossip.—Lawson's fiasco over the Santa Rita (in New Mexico) ended in his seeking the help of Haden, Stone & Co., who relieved him of his opinion on the mine and organised a strong company, including several of the big operators in Utah and Arizona. San Toy, floated by Schwab, has been an active stock; the mine is in Chihuahua. Hammond has been successful in making a big deal at Pachuca; Cortlandt Palmer and Hugh Rose are interested with him in the sale of the Santa Gertrudis to the Camp Bird company. The first intention was to do business with the owners of La Blanca but the dip of the vein is such as to take it into Santa Gertrudis ground, so negotiations were switched from one property to the other. Since then Hammond has been threatened with a libel suit by Eagan. The El Tigre option was not exercised by Leggett and Hellmann; they found a fine mine, but not quite enough ore to warrant the price. This mine was previously under option to the Consolidated Mines Selection Co. (of London) and was turned down; later on, other London parties looked into the proposition, but the views of the owners with regard to the ratio of profit assured to price demanded, did not appeal to British speculators. An interesting story comes from Mexico, concerning the Cinco Minas, a group of mines in the Hostotipaquillo district. H. E. Crawford reported on these mines; in consequence, the Marcus Daly estate sent E. A. Wiltsee to make an examination. Wiltsee reported adversely, but Crawford persevered and finally got an extension of time, permitting John B. Farish to visit the mines. Farish confirmed Crawford's report and now a deal has been arranged for 530,000 pesos, the first deposit of 50,000 pesos having been made. Farish has also been active in Guerrero, where he has taken an option on the Campo Morado. W. Murdock Wiley has taken up some claims near the Ray group, in Arizona, and has incorporated the Ray Northern, acting on the expert geological advice of Walter H. Weed. The General Development Co. has purchased the Planet mine in Yuma county, Arizona. This is an old property and has produced some rich ore. The General Development Co. (for which J. Parke Channing is advisory engineer) has also acquired the

Keystone mine, near the Miami, at Globe, Arizona. In this mine, from a shaft 200 ft. deep, a cross-cut of 200 ft. and a drift 100 ft. long have penetrated a large orebody in porphyry. The company now formed to take over this mine has a capital of $600,000 in $5 shares, of which $300,000 will remain in the treasury for the present.

Another Goldfield. — From Nevada comes the news of another excitement in the desert. The new camp is called Atlanta; it is near the site of Silver Park, which was active during the days of the White Pine boom in 1872. The ores mined at that time resembled those of Tintic. In October 1907

a woman, who served as cook to some prospectors, found a gossan showing free gold. Then and there she located four claims. These have recently been acquired by John L. Giroux and Elmer M. Bray of Los Angeles. A shaft sunk to 80 ft. has found good ore and prospects are so good as to have attracted a rush of prospectors from Pioche and other camps in eastern Nevada.

Cobalt.—The fire of July 2 destroyed about 200 flimsy structures and made many people homeless, but there was no great loss (only $400,000) of property and the mining industry has not suffered. The area devastated is mainly on Nipissing ground; the clearing of the surface will expedite prospecting. Ore shipments continue heavy, notably at the Nipissing, Drummond, and La Rose. The Provincial Government has decided to sell the Provincial mine, which after three years of work is a failure. In deference to the sentiment for public ownership, this mine on the Gillies Timber Limit was retained for the Province of Ontario and was exploited as a public undertaking for the sake of revenue, but in the end, the Premier, Mr. Whitney, has been compelled to confess that the property is a white elephant. The 30 acres of ground, together with 20 other lots on the 'limit,' amounting to 350 acres, are to be offered under competitive tender on September 13, subject to a royalty of 10% on the output.

REDRUTH

Retrospect.—During the years 1906 and 1907 there was a boom in Cornish mining, consequent on the highest price ever paid for tin. The top prices were £215 and £200; the lowest prices were £161 and £115, respectively. Several attempts were made to re-open old mines, but in almost every case with insufficient capital; hence all of these mines have had to suspend operations or to apply for more money.

Let us look briefly at the new ventures first, then at the old ones. In the Callington district there is Hingston Downs, which is still at work, but has had to reconstruct and has not yet reached the self-supporting stage. Electric pumps, as well as the Cornish pump, have been tried here. In the Liskeard district Phœnix Mines has had to reconstruct and form a separate company apart from, but not independent of its parent, the Cosmopolitan Proprietary. In the new deal two directors from Cornwall were placed on the board. The principal work done during the 2½ years has been the making of a royal passage through the adit, and the sinking of a large vertical shaft 100 ft. deep—perhaps too large—and the erection of a big Cornish pumping engine. South Phœnix has been less fortunate; after securing ample machinery, but not erecting it, this mine is now simply marking time. In the St. Austell district, the Great Dowgas mine, after spending £40,000 on electric pumps, electric compressors, air-cushion stamps, etc., has had to close for a while and efforts are again being made vigorously to develop this shallow property. If surface indications are a guide, this mine should do well. Alfred Mines, at Perranporth, is now being worked for zinc, blende, and copper by the debenture-holders, for a period of six months; thus far, the test has been satisfactory. A few initial mistakes were made, but they were not costly.

Truro District. — The Falmouth Consolidated, including mines so well known in the past as Wheal Jane, West Wheal Jane, Nangiles, Falmouth, and Wheal Sperris, after spending over £50,000 in machinery and development above the adit-level, had to close for a period of nine months. The property is being prepared for unwatering. Over 3,000 tons of ore was milled here in seven ball-mills, but these have since been sold by order of the Court. The yield from the ore was about 25 lb. black tin per ton. The ore is extremely complex. The plant consists of a suction gas-producer and electric winding-engines, equal to 1,000 h.p. Great Wheal Busy has had more than its share of trouble with an electric pump; and so has the contractor who supplied the pump, for he has lost a lawsuit over it. An 80 in. Cornish pumping engine is being brought from Wales to be installed at this mine. French and Belgians are supplying the capital. It is generally believed that this is a good property. The Tywarnhaile Syndicate, having spent over £20,000 in unwatering a copper mine, has now dismantled its plant, save for the Elmore machinery.

St Ives District.—Wheal Sisters, Wheal Reeth, and Worwas Downs are all quiet, although many thousands of pounds were spent on them at surface during 1906 and 1907. The Providence mines were idle for a few months and the surface presented the appearance of a second-hand junk and machinery yard, but now that Capt. John Penberthy, of Mexican and Bolivian fame, is at the helm, success is possible. In the Breage district, Wheal Vor is still at work but far from self-supporting; additional capital to the extent of £12,000 has recently been subscribed, but the mine has not been unwatered. Other prospects situated near Ashton and Gurlyn, after the spending of a few thousand pounds, are now quiet.

Dolcoath is still the premier mine of the county and sells more than one fourth of the tin raised in Cornwall. This mine has a bright future, as the bottom levels are opening up well, and when the new or Williams shaft has been completed, in about twelve months, many economies should be introduced both underground and at surface. This shaft has cost £81,000 to June 30, 1909; it is a vertical shaft of 17 ft. 6 in. diameter and is lined with nine inches of brick. The last dividend of 6d. per share was paid on August 28th. Condurrow, in the Carn Brea district, has been an utter disappointment so far although £40,000 has been spent and £14,000 is now wanted to unwater the mine to the bottom. The tradition of rich stopes in the old workings has proved an illusion. At the Parbola mine over £30,000 has been spent in alternately working and stoping during the past 2½ years; but little tin has been produced. This mine is worked on an 'elvan' impregnated with horse-hair seams of black tin running at right angles to the dike.

Levant is an old 'stand-by,' it is still operated on the cost-book system, and continues to prove a good mine, but it is severely handicapped by a scarcity of good shafts, rather than the scarcity of mineral. Mention should be made of Mulberry Hill, where an attempt to quarry rock carrying 6 lb. of tin per ton resulted in a loss.

Future Prospects. — During the boom nearly £1,000,000 was called up for various enterprises and thus far practically no return has been made. Why? Because there has been no systematic attempt at development. Companies with £10,000, £20,000, and £40,000 have freely spent their little money, have erected buildings, and have partly failed, whereas, if a strong company had been formed, after a thorough geological examination had been made, to work a group of claims, the chances are that enough mineral would have been found in some of the claims to make them dividend-payers. The past booms in Cornwall have been simply attempts to work at haphazard on any piece of ground that has been secured from any landowner, irrespective of present value, but with a record—real or fictitious. The next boom in Cornwall will be one of large companies, not companies with £40,000 capital, but with £400,000 or more; not high-grade propositions, but propositions that will assay 8, 10, or 12 lb. tin per ton; not deep worked-out mines with bones picked, but comparatively unexplored properties. The stock value of all the mines in Cornwall at the present time is less than £800,000, yet it is stated that one firm alone has 'called' for nearly that amount during the last four years.

METAL MARKETS

COPPER.

Affairs in the copper trade ruled very quiet in the early part of August; while consumers both in America and on this side were indifferent and only covered their immediate requirements, leading producers maintained their prices, allowing whatever business was passing to be taken by secondhands. The publication, however, of the figures of the American Copper Producers' Association on August 10, showing a sensational and totally unexpected decrease in the stocks there of 14,403 tons, quite changed the aspect of affairs. This was reflected in the London standard market, where a heavy rush of bear covering-orders quickly drove the price of forward copper up to £61 10s., an advance since the beginning of the month of £2 2s. 6d.; thereupon, the consumers, becoming alarmed, changed their attitude. Large transactions in refined copper took place both in America and Europe, and the producers were enabled to obtain their prices, not only where consumers were concerned, but also by selling on the London market. The situation looked healthy and favourable for a further advance, but the slump in securities on the New York Stock Exchange, consequent on the reported illness of a well-known railroad financier, checked the movement, and the copper market relapsed into its previous dullness. Closing prices, however, show an improvement, as compared with the commencement of the month, of practically £1 per ton.

The visible supplies in England and France on August 31 show an increase of 11,659 tons, amounting to 88,218 tons as against 76,559 tons at the end of July.

The continuous expansion in the American iron and steel trades has naturally led to an increased demand for copper, as witnessed by the American statistics, which showed the record figure of 33,386 tons delivered to home consumers. It is not unnatural to expect that the welcome improvement that has taken place in the iron industries on this side during the recent few weeks, will also lead to a similar state of affairs in copper. Already consumers are showing more inclination to contract for forward requirements, while India has placed orders for copper and yellow metal squares, with more freedom than for some considerable time past.

August 1909.	July 1909.	August 1908.
£59 10s. 2d.	£58 14s. 1d.	£60 13s. 9d.

TIN.

Great activity has prevailed in this market during the month, and prices have appreciated considerably. Although generally one of the slackest months of the year, the American demand has exceeded all expectations, while the tinplate industry in this country has also been in a very healthy condition. Favoured by statistics that were not so bad as was generally expected, the bull party was able to assume control, and their efforts were successful in advancing the prices from £135 10s., at which it stood at the beginning of the month, to £141 5s. three months; although the latter level was scarcely maintained. In view of trade prospects, the outlook for this metal is good, and higher prices are not unlikely in the near future.

LEAD.

There has been a little more life in this market than for some time past, although the building and electrical trades in this country still leave a great deal to be desired. Toward the close of the month consumers came out more freely and a fair business was done. In sympathy with other metals, prices have improved slightly. Closing prices were round £12 12s. 6d. to £12 15s. for foreign lead, ex ship London.

SPELTER.

The dissolution of the Galvanized Iron Association at the close of July, and the subsequent cutting of prices, has led this month to a buying movement which is probably unparalleled in the history of this branch of industry. The price of galvanized sheets, which had stood round £12, was quickly reduced to £10; at this price an enormous demand set in, which successive advances have been powerless to stop. A large business has been done with galvanizers in spelter, and although the Spelter Syndicate, after selling freely, advanced their prices 10s. per ton, the demand is still unabated. A good business in sheet zinc has taken place at advanced prices. Altogether the prospects of this metal are very healthy, because while galvanizers are only covered in spelter until the end of this year at the utmost, their bookings for galvanized sheets extend well into the first quarter of next year, and the chances are all in favour of still higher prices in the near future.

The Wear of Coins.

FOR some years T. Kirke Rose has been making investigations into the life and rate of wear of gold and silver coins, and has collected, in his capacity as chemist to the Royal Mint, a large amount of information. His first paper on the subject was published five years ago, and his second appears in this year's Report of the Mint. An abstract of his figures and conclusions will prove of interest to our readers. Taking first the case of gold coins, he examined a thousand light-weight sovereigns returned to the Mint for re-coinage, every year from 1904 to 1908, inclusive. The average age of these 5,000 coins was 24·39 years. In referring to his previous report it appears that the average life of withdrawn sovereigns during the years 1899 to 1903 inclusive was 27·27 years. It is difficult to deduce any conclusions from these bare facts, and Mr. Rose does not attempt to do so, but the presumption is that coin goes into and out of banks more often nowadays, seeing that almost everyone, even the humblest, keeps a banking account, and that the banks are keener in keeping an eye on worn coins. It is interesting to note that of the 1,000 withdrawn sovereigns examined during 1908, ten were so old as to have been issued before 1850, and five were so recent as the period from 1901 to 1908. The chief bulk of the withdrawals were issued in the 70's, 80's, and 90's, the figures for which were 300, 321, and 287 respectively. Mr. Rose says that in a few years sufficient statistics will have been collected to make it possible to determine with some approach to accuracy the proportion of the issues that are returned for re-coinage and also the mean length of life of all sovereigns instead of the life merely of those that are returned to the Mint. From present indications he gives it as his own opinion that of the older issues of sovereigns, about one in four is returned to the Mint, the others coming to an end in other ways. The ultimate destination of the other three is a matter of uncertainty.

As regards returned half-sovereigns, Mr. Rose reports that 10,000 have been examined during the years 1904 to 1908, inclusive; their average age was 15·355 years, as compared with 16·24 years during the period 1899-1903. It is a curious fact that though, as mentioned above, one in four of the older sovereigns finds its way back to the Mint, practically all the half-sovereigns do so, sooner or later. It may therefore be taken as a reliable estimate that the average life of all the half-sovereigns coined is between 15 and 16 years. During 1908 the bulk of the withdrawn half-sovereigns were issued in the 90's, the exact figure being 1,772 out of the 2,000 examined.

We pass now to the result of investigations relating to silver coins, and in doing so, it is desirable to point out that the law relating to the currency of worn silver coins is entirely different from that of gold coins. In the case of gold coins the new sovereign weighs 123·27 grains and when the weight decreases by wear to 122·50 grains the coin ceases to be currency. On the other hand a silver coin is current as long as the design or impression is not obliterated.

The examination of worn silver coins has not been so complete as that of the gold coins. The most recent examination was made during the current year. Rather over 5,000 coins of five denominations, namely, half-crowns, florins, shillings, sixpences and threepenny bits, were examined. By weight the average deficiency was about 10% and was greatest in the case of sixpences. There is difficulty often in ascertaining the actual life of the coins because the date is entirely obliterated. As a matter of fact about 25% were illegible. The greatest proportion were among the sixpences, no less than 46·5% having no recognizable date. The average date of the silver coins with legible dates was 40 years. The average age of sixpences was 24 years, three-pences 29 years, shillings 40 years, florins 47 years, and half-crowns 62 years. By reasoning from a series of collateral facts, it was estimated that, including illegible coins, the average life of all silver coins would not be less than 43 years, and the separate figures for sixpences, three-pences, shillings, florins, and half-crowns were 28, 33, 41, 47, and 64 years. Mr. Rose estimates the yearly wear of silver coinage to be £94,000, taking the silver at its coinage, not market, value.

The Oxidised Ores of Antimony are now usually regarded as metasomatic in origin. For instance the deposits at Constantine, Algeria, consist of oxides in irregular layers running parallel to the beds of black carboniferous limestone. At one time the ores were supposed to be sedimentary, but now the theory of replacement of the limestone is found to be more in accordance with facts.

DISCUSSION

Our readers are invited to criticise anything appearing in this magazine and to discuss other subjects of general technical interest.

PRINCIPLES OF MINING.

The Editor:

Sir,—In mining engineering, as in all human endeavour, a free interchange of ideas must work toward perfection. And since nothing brings out opinions, theories, and facts so well as discussion, it is with the hope of starting a discussion that I write these remarks on H. C. Hoover's book, 'Principles of Mining.' This remarkably clever book should be read by everyone who deals in mining shares and should find a place in the library of every mining engineer, no matter how complete his knowledge or wide his experience.

I mention here a few of the many points that seem worthy of further examination. Mr. Hoover's most novel contribution to mining literature is found on page 31, where he discusses the probabilities of ore extending in depth, and states that these probabilities are in proportion to the length and width of each orebody. He says: "For instance, in the A mine, with an oreshoot of 1,000 ft. long and 10 ft. wide, on its bottom level, the minimum extension under this hypothesis would be a wedge-shaped orebody with its deepest point 500 ft. below the lowest level, or a minimum of say 200,000 tons. Similarly, the B mine with five orebodies, each 300 ft. long and 10 ft. wide, exposed on its lower level, would have a minimum of five wedges 100 ft. deep at their deepest points, or say 50,000 tons. This is not proposed as a formula giving the total amount of extensions in depth, but as a sort of a yardstick which has experience behind it." I notice that in this calculation Mr. Hoover takes the thickness at 10 ft. throughout, but it seems more natural to assume that the ore decreases in thickness, as well as in length and depth, and thus to assume a less tonnage. If intelligently applied, this rule of Mr. Hoover's will serve a useful purpose for roughly approximating the possibilities of an orebody in depth, but—as he points out—its application is only to fissure veins. A tabulated statement of the behaviour of a large number of fissure-vein orebodies in depth would be of great interest. Perhaps St. John del Rey, with its history of continuous working for 75 years, is the veteran among gold mines, but other gold mines have a record of many years. The Grass Valley mines, for example, began crushing ore in the fifties, and to-day show no signs of exhaustion in their lowest levels. Although no profit has been made by the Comstock mines from the ore found on the 3,400 ft. level, nor by the Bendigo mines from the ore found at 4,000 ft., yet this discovery of good ore at great depths will lead to development work that will add greatly to the lives of the mines in these districts. The Lake Superior mines are making profits from ore taken from stopes more than a mile below the surface, and it will not be long before the Rand will get dividends from mines worked to as great a depth, and there is no evidence that these deposits are giving out in depth. From a consideration of such facts, and giving due weight to the advances certain to be made in mining methods and metallurgical processes, I think it is evident that there is a long life ahead for many mines now operating, and that many of them will be found active a century hence.

On page 101 it is stated: "The minimum stoping width which can be consistently broken with handholes is about 30 inches, and this only where there is a considerable dip to the ore." This seems to me rather wider than is necessary, for I have worked stopes with a width of 18 inches in Nevada and California. Le Neve Foster says that a stoping width of 23 inches is aimed at in the Mansfield copper mines, and that stopes as narrow as 15¾ inches are worked; in coal mines 15-in. seams are considered workable.

In Chapter XXI. Mr. Hoover discusses the efficiency of labour. His wide experience in different parts of the world makes his opinion of great value. This question has been recently discussed by J. R. Finlay in the *Engineering and Mining Journal*. Mr. Finlay and Mr. Hoover agree that the labour cost is practically a constant, and that cheap labour simply means inefficient labour. Mr. Hoover seems to fully prove his contention by the table on page 164, where he compares costs in various countries. However, I think there is something to be said on the other side, and I believe that there is such a thing as really cheap labour, and that the lowest working costs will ultimately be reached in such countries as China and Korea, where remarkably cheap and efficient labour is found; indeed, low costs have already been attained in these countries. The reason for the high mining cost in Asiatic lands is to be found not so much in the inefficiency of the native, as in the way he is treated. For instance, in the mines of the Ural the sturdy Tartar from the Volga earns his 16 pence daily by gently tapping, with short-armed strokes, a pointless drill with a shapeless mass of iron, only called a hammer by excess of courtesy; in Nevada his brother Russian earns a daily $3·50 for his full-armed blows, which drive a sharpened drill with a well-balanced hammer. The increased skill of the Russian working in Nevada is aided by constant and intelligent supervision, while the Ural workman labours under loose and inefficient management: the final result is that the labour cost of breaking ground in the two countries is not widely different, and, on the whole, the Nevada figures are probably best. But a slight change in tools and management ought to reduce the costs in the Urals below those in Nevada; in fact, my own advice to a manager in the Ural, simply telling him to increase the air-pressure at his machine-drills, and to change his organization of miners and shovellers, enabled him to double the rate of progress in driving, and thus nearly halved his cost for that work.

When I was on the Gwendoline mine in Korea the underground foremen, men of world-wide experience, united in saying that the Korean miner could break ground cheaper than it could be done either on the Pacific Coast or on the Rand. S. J. Speak (Trans. I. M. & M. Vol. XII. p. 240) mentions a probable contract cost in the American concession mines in Korea of 15s. per foot for drifts in granite, including dynamite; this certainly is remarkably low.

As bearing on this question, it is well to reflect on the extremely low cost of some articles in the countries where cheap labour exists. In China, in the province of Shansi, I have seen good coal sell at the entry for a shilling per ton, and inferior coal for five pence. In this same province cast iron of good quality sells for £1 per ton—a record price. Turning to foods, I find that eggs sell in Shansi for as low as two *cash* each, or at the rate of less than six pence per hundred. In the Ural I have bought potatoes for about 30s. per ton. These remarkably low prices show, in some directions, a very low labour cost; similar low costs will be reached in mining and other departments of human industry when this cheap labour is properly organised and administered. A full consideration of this problem would lead to an investigation of the relative powers of the white and colored races, and would be of the greatest interest. Some of your readers are exceptionally well fitted for giving information on this subject.

The statement on page 179 that "where the plant is paid for out of capital provided for the purpose, even to write off depreciation, means that a corresponding sum of cash must be held in the company's treasury in order to balance the accounts" seems a reflection on the ingenuity of accountants, for it seems as if there should be some way by which this cash could be utilized in mining development, even if it could not be paid out in dividends. The discussion in Chapter XX. leads me to ask: Can precious-metal mines ever be regarded as investments? The text seems to indicate that a prudent layman may, by diligent inquiry, find opportunity for the profitable investment of his funds. There are, however, a large number of engineers who think that shares in mines of this class are always in the nature of lottery tickets, and should only be purchased by speculators. If there are any precious-metal mines whose shares can be recommended as proper investments for trustee funds, I should be glad to hear of them.

The lot of the bridge engineer, as indicated on page 190, may be a happier one than that of the mining engineer, but the civil engineers whom I know seem to have as many cares as the rest of us. Care is more an individual than a professional attribute; and when one considers the worry the bridge engineer has in attempting to reconcile the demand for safety with the demand for profit, and when one remembers the horrible failures, and the resultant loss of life when important bridges, built by leaders of the profession, have failed to properly reconcile these conflicting demands, I do not know that the mining engineer should wish to exchange his burdens for the loads of the bridge-builder.

W. H. SHOCKLEY.

London, August 19, 1909.

Bismuth is produced as a by-product at two works in the United States. At the plant of the United States Metals Refining Co. at Grasselli, Indiana, it is recovered from the slime produced in the Betts electrolytic process for the refining of lead, and at the National Lead Co.'s works it is found in the residue produced in the manufacture of lead acetate.

INVESTMENTS AND SPECULATIONS

By A PROFESSIONAL SPECULATOR

[This appraisal of the present value of mining shares is contributed in good faith by a speculator unusually well qualified to form a just estimate. There is plenty of chance for disagreement with his verdicts on various enterprises, but we deem the information valuable to our readers and interesting to the public.—EDITOR.]

THE valuation of a mining share being the valuation of a whole mine divided by the total number of shares, it follows that there is no reason why the same principles and skill cannot be applied to this appraisal as to mine valuation. The value of a share for speculative purposes is therefore a matter of profit in sight; probabilities of more ore; annual return; management; cash in hand or liquid assets; the outlook of the metal market; and finally the price of the share.

One thing must be borne in mind at all times: The following tables are based on the mines and the merits of the shares, not on the manipulations of the market. Many a share in all classes may be boosted or depressed by market influences, independent of all merit, but in the long run the pendulum will swing back to merit only. The determination of these factors over a large portion of the mining share-list is no easy matter; it requires a wide actual experience among these mines; a knowledge of their personnel; an active and extensive bureau of information. In fact, it is the result of hard work and diligent enquiry. If conducted on this basis, it becomes just as sound and respectable as the conducting of an exploration company for the purchase of whole mines, with the advantage over that business that shares can be purchased without negotiation, they can be borrowed upon, and can be sold without delay.

The gradual extension of a large class of such professional speculators with an organised staff, agents, and correspondents, has greatly strengthened the finance of the industry by providing facilities for obtaining capital for meritorious undertakings. Every week in my office are tabulated the various shares of certain classes of mines in order of merit according to my views. The relative place of any share in this list may change in an hour by extension of development, rise or fall in quotation, change in management, or the state of the metal market. Personally, I prefer shares outside the South African list because, while the majority of these have merit, it is difficult to find one that could be expected, even with optimism, to pay 7% and return the capital, and, further, the whole market moves together, whether good or bad, that is, the most meritorious share falls in price and remains low for long periods for reasons not even remotely connected with the mine.

My classification is as follows:

I. **"Excellent."** — The management, proved value, and speculative chances are such that, compared with the price, no engineer would hesitate to recommend the purchase of the whole mine at its market value. It is considered that an investment spread over this list is certain of ultimate profit.

II. **"Fair."**—The proved value is less, but the speculative possibilities are very good, that is, the mines are good in the bottom workings or the company has other assets with sound prospects. This class is kept under close surveillance as the members of it may at any time advance to Class I. either by fall in price or improvement in outlook. An investment spread over this list is considered to be without risk of ultimate loss and possesses a speculative chance of profit.

III. **"Moderate."**—These are concerns with less proved merit but fairly good speculative chances. The chance of loss in this list is considerable. Fortuitous circumstances often provide large profits, but these enterprises are highly speculative at the price of to-day.

IV. **"Indifferent."**—These are shares that have some value, but they exhibit a great gap between price and merit. These are not likely to come into Class I. except by the most astonishing chance of fortune; as an investment they rank with roulette.

V. **"Remote."**—These, as an investment, rank with the Honduras State Lottery.

(See next Page).

GOLD SHARES. AUSTRALIA.

I. Excellent.	II. Fair.	III. Moderate.	IV. Indifferent.	V. Remote.
Ivanhoe	Great Boulder	Associated	Chaffers	Central and W. Boulder
Horseshoe	Kalgurli	Associated Northern	Boulder Perseverance	Cosmopolitan
Mt. Morgan	Lake View	Golden Links	Great Fingall	Gt. Boulder M. Reef
	Oroya Brownhill	Gwalia Consols	Hainault	Northern Territories
	Sons of Gwalia	Oroya Black Range	Northern Mines	Myalls and Peak Hill
	Waihi	Hannan's Star	Mt. Boppy	Gwalia Proprietary
		Lancefield	N. White Feather	Orion
		Con. Goldfields of N.Z.	Boulder Deep	Berry United
		Blackwater	Sth. Kalgurli	Brilliant
		Waihi Grand Junction	Tasmania Gold	Day Dawn Block
			Mills Day Dawn	Queen's Cross
			Progress Mines	
			Talisman	

GOLD SHARES. WEST AFRICA.

I. Excellent.	II. Fair.	III. Moderate.	IV. Indifferent.	V. Remote.
Cinnamon Bippo	Abbontiakoon	Appantoo	Ashanti G. C. United	North Tarkwa
Prestea Block A	Abosso	Bibiani	Champion Reefs	Offin River
	Ashanti Goldfields	Broomassi E	United Exploration	West Africa Development
	Fanti Consolidated	Effuenta	Sansu	Obuassi Syndicate
	Gold Coast Amalgamated	Fanti Mines	Wassau Central	
	Prestea Mines	Himan	Wassau West	
	Tarkwa Explorations	Wassau		

GOLD AND SILVER. AMERICAN.

I. Excellent.	II. Fair.	III. Moderate.	IV. Indifferent.	V. Remote.
Mexico Mines of El Oro	Alaska Mexican	Camp Bird	Barranca	Carmen Mines of Mexico
	Alaska Treadwell	El Oro	Brazilian Goldfields	Le Roi
	Alaska United	Esperanza	B.C. Smelting	Great Bonanza
		Orcville Dredging	Kerr Lake	Stratton's Independence
		Tomboy	La Rose	Van Roi
		Exploration Co.	Le Roi No. 2	Ymir
			Peru Mines & Estates	Austin-Manhattan
			St. John del Rey	
			Tominil	

1–4

Gold Shares. Rhodesia.

Antelope	Bechuanaland Exploration	London & Rhodesia Mining
Eldorado Banket	Chicago Gaika	London Wall Trust
Enterprise	Gaika Development	Matabele Central Estates
Giant Mines	Jumbo	Selukwe
Globe & Phœnix	Selukwe Columbia	Surprise
Rhodesia Banket		Wanderer
		Rhodesian Consolidated

Lead, Silver, and Zinc.

Broken Hill Block 10	Block 14 Pref.	Sulphide Corp., Ord.	British Broken Hill	Linares
Broken Hill North	Sulphide Corp., Pref.	Broken Hill South Block	Broken Hill Proprietary	
Zinc Corporation, Pref.	Zinc Corporation		B. H., Block 14, Ord.	
	Brcken Hill South		San Francisco Del Oro	
			Weardale	
			B. H. Junction North	

Copper Shares.

Mt. Morgan	Arizona Pref.	Esperanza	Amalgamated	Chillagoe
Great Cobar	Mt. Elliot	Huelva	Anaconda	Corona Queen
Miami	Spassky	Mason and Barry	Boston	Mt. Lyell Comstock
Ray Consolidated	Utah Copper	Otavi	Cape	Mt. Lyell Consols
Great Fitzroy	Nevada Consolidated	Rio Tinto	Famatina	Mt. Molloy
Mt. Lyell	Gila	Tharsis	Libiola	Mungana
	Ray Central		McGregor Cloncurry	Nevada-Utah
			Messina	Phillips River
			Namaqua	Queensland Exploration
			New Einasleigh	Union Consolidated
			Oonah	Utah Bingham
				Whim Well
				Widin

September 5, 1909.

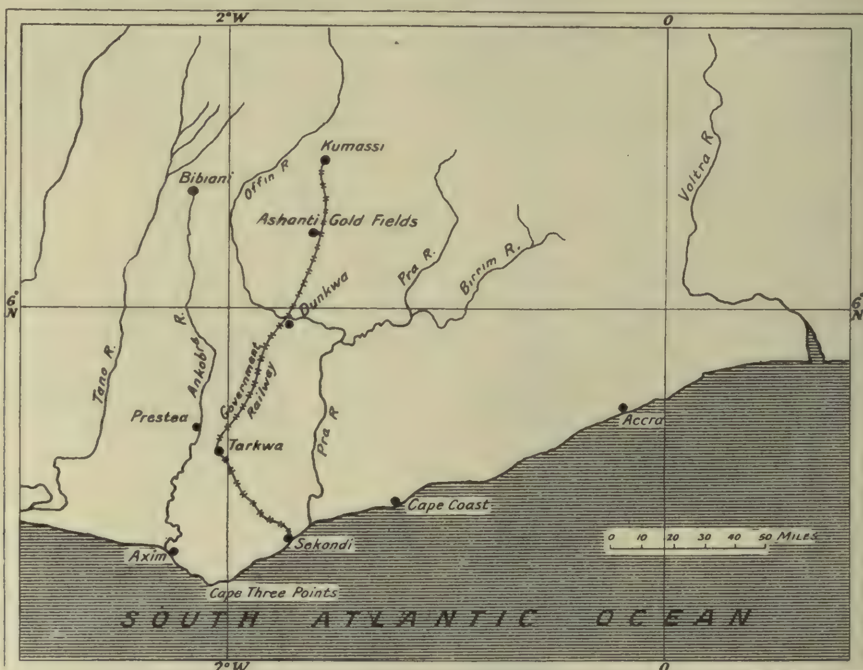
WEST AFRICAN MINES

By J. H. CURLE.

IT is related that Naaman the Syrian, incipiently leprous, took counsel of a healer, and was bidden, by way of cure, to bathe seven times in the river Jordan. A command so simple, so unheroic, did not carry conviction to him. "This is too easy" (I quote from a Sanskrit palimpsest) were the words he spake. So Naaman the Syrian disregarded the advice of the specialist, and presently suffered a dreadful fate.

About a year ago the West African Mining Industry was in a state of horrible disease, and Naaman, in the shape of stricken people who controlled these mines, again listened to one who spake words of healing. This man (whose name modesty forbids me to set down) was no miracle-worker. He did not tell Lord Harris to lave in Offin, nor Mr. Edmund Davis to disport himself in the Ankobra. But he was quite an intelligent person, and he gave advice that, in its tenor, was as curiously simple as that given to Naaman by the seer of old. He said hardly anything about winzes or stopes; about cyanide extractions he was more than reticent, and he did not even mention the word 'tube-mill.' What he did say, pregnantly and indubitably, was this: "Get rid of the mosquitoes."

Again Naaman is face to face with what is simple and unheroic, and again, it may be, history is going to repeat itself. "Why," he keeps thinking, "Why this damnable iteration about mosquitoes?" What *can* they have to do with gold mining? What does the public care about mosquitoes, anyway? His head is full of development schemes; of ore reserves; of reconstructions; of issues of reserve shares, but the one vital thing, if I read the signs aright, is not there. He must kill that little creature whose surname is Anopheles, or it will kill him; that is the only problem that matters in West Africa just at present.



The West African Goldfields.

Well, the fate of Naaman the Syrian is again in the balance. He can grasp the vital point for once and for all, or he can let it slip. If he does the former, he will make a success of this industry. If he does the latter, he

The Tarquah Mining and Exploration Co.'s Plant at Tarkwa, West Africa.

will again, as in the days of the prophets, "go out a leper as white as snow."

We miners have fought nature in every part of the world, and we are not going to be beaten by this West African forest. Potentially a great goldfield lies there, and this potentiality can be translated into fact. But there is only one way of doing this. Climatic conditions, and the health of both whites and blacks, have got to be altogether improved. These things can be done; that is the saving fact of the whole position; but until they are done we shall not see real progress in West Africa. Malaria, and the malaria mosquito, must be eradicated. This taking of five grains of quinine daily, a necessity that stamps the West Coast before all the world as accursed, and often sends a man back in a year—a bloodless wreck—to England, must cease. The forest should be cleared for at least a mile round each mine. Thick Bahama grass, through which little or no undergrowth springs, ought to be sown over these clearings. All stagnant water should be drained. All sanitation, in the white bungalow no less than in the native village, must be under supervision. Finally, the food supply needs to be greatly improved. The present cold-storage plants are defective; they must be altered. The mining companies ought to supply white cooks and bakers, and should, preferably, compel their white men to eat at a boarding-house, where the quality and variety of food can be guaranteed. These are the things that are going to make or break West Africa. They are the only things that really matter at present.

Granted a real change in the health factor (but not until then), the Gold Coast is going to develop into a great asset. For years we have been scouring the world for a new goldfield. Here it lay, had we but known, and in a British colony too, but the dense forest and the deadly malaria dimmed the imagination that was in us. G. A. Stockfeld, alone among the earlier managers, showed real faith in the country; his name should not be forgotten.

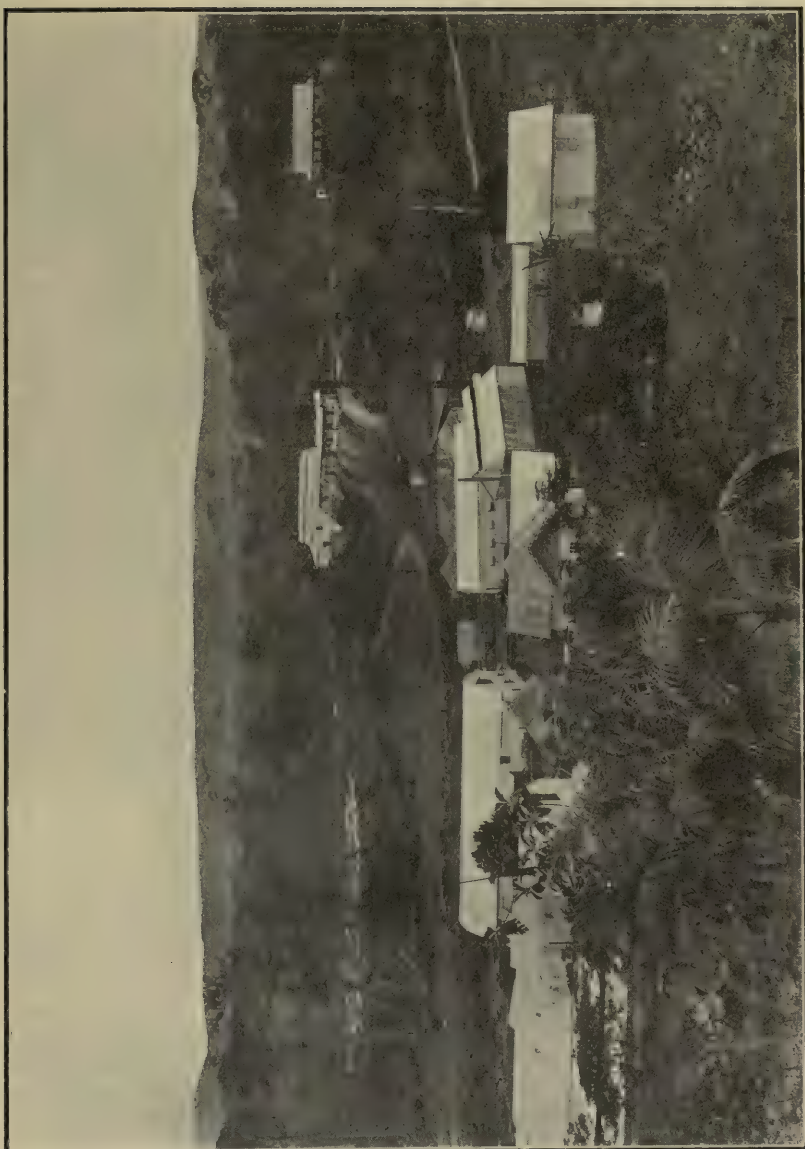
What are the economic factors in this region? Transport is good. A railroad from the coast now taps the mines at Taquah and Ashanti, and in a few months will reach Prestea. The only large orebody not tapped by rail is Bibiani, which lies some 70 miles off the line.

Labour locally is not abundant. This before long would become a serious problem, but for the fact that in the hinterland of the colony is a large supply that can be drawn upon. The natives of the hinterland can be secured only by permission of the Government, but this has been given. I understand that the relation between the Government and the mining companies on the whole question of native labour are now harmonious. As for the native himself, he is head and shoulder above all the blacks of Africa in intelligence. I rate him above the Chinaman. I rate him even above the Korean, who is the best coloured miner I have seen. This clever Gold Coast native, with a little teaching, can mine ore, drive an engine, or run a lathe as well as any white. What he lacks at present is the incentive to work. This incentive can be supplied. He must be taught to set aside bananas and nuts for food of greater variety and delicacy; to wear European dress on Sunday; to clothe his women in purple and fine linen; to buy musical instruments and gramophones, bicycles, watches, and jewellery. In brief, he must be taught to grasp at a higher standard of comfort or even luxury. To supply his wants he will work harder and more regularly. In so doing he will be neither harmed nor degraded, and the result will mean a difference to the mining industry that can hardly be measured by figures.

Economic conditions in the Gold Coast, therefore, are favourable. Always setting aside the climatic factor, they are, for a mining region, above the normal. Granted orebodies of fair size, that break well, indications favour unusually cheap production.

Landing from a surf-boat at Sekondi, a railway journey of 39 miles, through dense forest, brings you to Taquah. The Taquah goldfield is a bed of conglomerate sufficiently like the Rand ore to be called 'banket.' So far as known it is 22 miles long; the average width of clean ore from end to end is probably not less than 40 inches, and its persistence in depth has been well proved by boreholes.

The bed carries gold throughout; but it is reasonably certain that much of it is too poor to work. I make this statement on the evidence of all development work to date and the results of some 50 or more boreholes. The richer zones appear more clearly defined than on the Rand, and evidence is favourable to their persistence in depth. These richer zones have been found, so far, in Taquah,



General View of Ashanti Goldfields Plant, West Africa.

Abosso, Cinnamon Bippo, Abbontiakoon, and Wassau; there is also reason to take a hopeful view of the ore in Fanti Mines and Gold Coast Amalgamated. This Taquah goldfield has the makings of a big industry, and my idea is that at least one-third of this bed can be regarded as profitable. Ore thus aggregating seven miles long, and mined for a width of four feet, will yield nearly 12,000 tons for each foot of depth. This may be regarded as a minimum estimate, but it is substantial enough to warrant a comprehensive prospecting of the bed from end to end. The average value to be recovered from this ore for, say, the first 800 feet of depth, I shall figure at 30 shillings per ton. It will be more than this on the mines that are now working with small plants, for on these the ore is at present submitted to an economic eclecticism; but the average figure, with newer mines soon to be started, should be 30 shillings. This is better than the Rand, where, as the general economic factor improves, the average will gradually fall to 25s. per ton, and later to 20s. As regards working cost, the Taquah field is the better favoured of the two. The older and smaller plants, those at Taquah, Abosso, Abbontiakoon, and Wassau, do not reflect conditions to the best advantage; but a new 100-stamp equipment on such a mine as, let us say, Cinnamon Bippo, should be worked more cheaply than any similar equipment in the Transvaal. I take it that no more small plants will be erected on the Taquah field, for the greater relative efficiency of larger units is now universally recognised. If the ore-shoots are not large enough to support individual 100-stamp mills, aerial trams must be built, and the ore from a group of small mines carried to a central equipment.

Some 20 miles from Taquah, with a branch railway thither nearly completed, lies the Prestea goldfield. Here the ore is a whitish quartz, and runs more or less continuously for several miles. There is a remarkable ore-shoot here; it appears to extend from end to end of Prestea Block A, which is nearly 5,000 ft. long, and averages in this property fully eight feet wide. At one end it runs into Appantoo, and at the other into Prestea Mines and Anfargah. In these extensions it is narrow as a rule, but the assay-value seems good, and all of the properties seem likely to be profitable. One central equipment on Prestea Block A should handle all the ore of this district. As to whether the group of mines should be formed into one is a matter for the shareholders, but any second crushing plant erected on the Prestea orebody would be a technical mistake of the first magnitude. The Prestea Block A, with a large modern mill, will be worked for appreciably less than 20s. per ton, while the whole of the ore exposed to date will yield over 30s. per ton. As it stands to-day, Prestea Block A is one of the finest quartz mines in the world. If there exists that relation between length and depth in an ore-shoot that some of us hope before we die to reduce to a formula, then the history of this mine should be a striking one for a number of years to come.

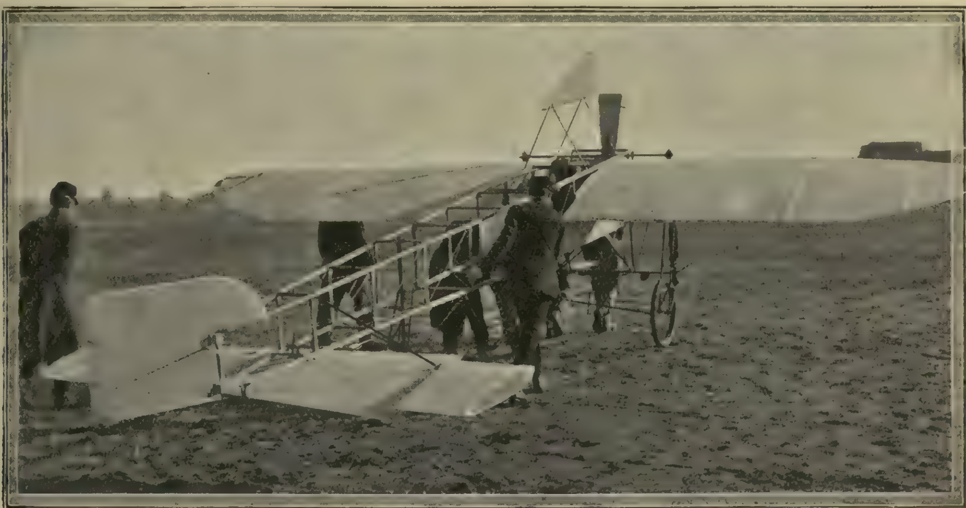
Some 80 miles beyond Taquah, the railway passes through the 100 sq. mile concession of the Ashanti Goldfields Co. This is a highly mineralized district; but an exact examination of its ore deposits will only be possible when the ever prevailing forest shall have been cleared. A year ago the company, not satisfied with the appearance of some of its older mines, despatched a skilled prospector into the forest and forthwith, almost at their back door, was discovered 'Justice's Find.' This is the ugliest looking orebody I ever saw—a mere impregnation—but it is 80 ft. wide, worth over 40s. per ton, and is already proved to the third level. After this the Ashanti company is capable of anything; I shall attempt no estimate of its value, but I should like to own what I conceive still lies hidden in this forest concession.

From Ashanti to Prestea, a distance of 70 to 80 miles, there is a gold belt as yet unprospected. It joins up these two important centres, and will some day, I believe, be dotted with productive gold mines. The whole country is worth prospecting, but this line is the likeliest of all. A gold belt lying between two such mines as Prestea Block A and Justice's Find should be prospected to the tune of a million pounds.

Gold Production. — "The Government statisticians have surprised Wall Street bankers by demonstrating that 82·7 per cent. of this year's total world-production of gold comes from earth under the British or American flags. The total gold production this year is estimated at $411,000,000, of which $340,000,000 is from the English-speaking countries." There was no need for this surprise; the fact has been emphasized every year; for the only important gold-producing region outside of English-speaking countries is Siberia.

CONQUEST OF THE AIR

WHILE most of us were still in bed and asleep, a flying man crossed the sea from France and landed quietly upon the Downs near Dover. That event enlarged human imagination to an incalculable degree, for it stimulated the hope that man having learned how to traverse first the land and then the water would now succeed in travelling through the air. It is true that the English Channel had been crossed in a balloon more than a century earlier and the crossing had been made frequently in later years by men thus suspended at the base of a large bag of gas; but this mode of travel, essentially fortuitous, bears no resemblance to the winged structure propelled by an engine, by means of which Louis Blériot crossed from Calais to Dover in half the time taken by the swift steamers that ply between the terminal ports of England and France. Before Blériot took his seat in the aeroplane he threw aside his crutches, for he had been lamed in an accident; he could not walk but he proceeded to prove that he could fly. At 4.35 on the morning of July 25 his flight began and at 5.12 he landed safely at the place selected on the other side of the silver streak separating Britain from Europe. The dominant fact in connection with this aerial navigation was not the swiftness of the passage but the aviator's ability to go to the destination selected by him; he went whither he wanted to go and thus proved his control of the aeroplane. The balloon borne on the breeze is to the aeroplane guided by an engineer as the raft floating with the stream is to the vessel propelled by steam and steered to a chosen port; it is the difference between chance and design. How long it will take to develop the aeroplane from a scientific toy to an accepted vehicle of locomotion no one can predict, but it is obvious that no voyage since that of Columbus is so fraught with possibilities of human achievement.

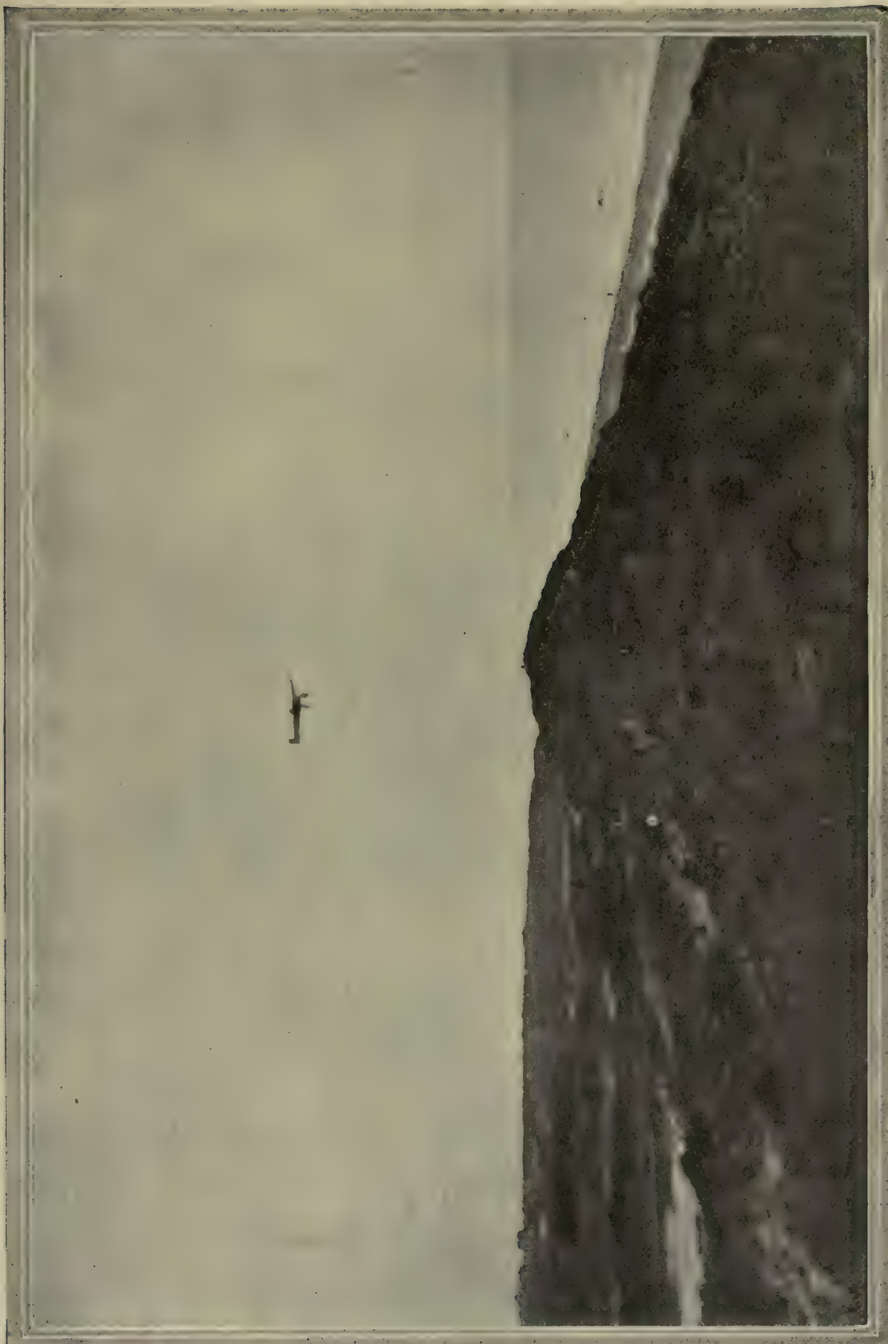


The Bleriot Aeroplane, No. XI. Reproduced by courtesy of 'Flight.'

A few details of Blériot's aeroplane will prove of interest to engineers, especially to mining engineers, whose ingenuity is mainly exercised in sinking deeply into the earth, and to whom therefore the idea of soaring through the enveloping atmosphere will seem attractively apposite. The machine used by Blériot on July 25 was a monoplane, that is, it had one deck only, as distinguished from the double deckers or biplanes of Wright, Farman, Delagrange, Sommer, and Cody. This aeroplane was No. XI., it being the eleventh constructed by the inventor for his experimental flights. The frame is composed of ash and poplar, stiffened with piano wire; it is a light lattice-work box-girder having a square section in front but tapering to an edge behind, where the rudder is attached. At the rear, but in front of the rudder, is a supplementary plane forming a tail. The frame weighs only 45 lb. and is only 23 ft. long. The pilot sits slightly forward of the rear edge of the main wings, which have a span of 28 ft. and a sustaining surface of 150 square feet. The engine is a 3-cylinder Anzani motor of 25 h.p., air-cooled, weighing 132 lb. and actuated by the explosive combustion of 'petrol' or 'gasoline.' This engine is placed just in front of the big wings and immediately above the two-wheeled *chassis*, which weighs 66 lb. and carries the fore part of the machine when at rest on the ground. The rear of the flyer rests on a single wheel of smaller dimensions. The weight of this aeroplane is only 520 lb.; with pilot and fuel in running order the total reaches about 705 pounds.

The wings are entirely covered, both above and beneath, with a waterproof material; the maximum thickness of the wings is only 3½ inches, the front and trailing edges being sharp. When in the air, at a distance, the depending *chassis* looks like the antennæ of an insect or the legs of a swimming bird, but when approaching the spectator the foreshortening and the speed combine to give the flying machine a more imposing appearance. The few who observed Blériot's approach to Dover unite in describing the aeroplane as a big bird, the hum of the motor being audible before the swift rush of the winged engine brought the machine into momentary view. We reproduce a photograph taken at the start of Blériot's voyage; this truly was a voyage of discovery, for he demonstrated that his aeroplane could be satisfactorily controlled while carrying more weight per square foot than it has hitherto been thought wise to attempt and more than mathematicians can explain; and he performed another astonishing feat: he destroyed the isolation of Britain, but not the insularity of Englishmen. Already we read the anxious protests of timid spirits who claim that not only is an Englishman's home his castle but that with it goes the prescriptive right to the column of atmosphere ("*usque ad cœlum*") supported upon the acreage of the garden or other land to which he holds title. But does the air belong to the leaseholder or to the freeholder, to the State or to the citizen? When the land legislation now the subject of protracted discussion in Parliament has been finally passed, must we anticipate a further bitter contest over aerial rights? This is not within our province to say; but even the humour of the situation cannot obscure the fact that the success of aviation must modify our whole conception of civilization; the world has been brought nearer together; either for ill, to facilitate contest; or for good, to promote understanding.

Since the above was written the art of flying has been further stimulated by the *Grande Semaine d'Aviation* at Rheims. This least pronounceable of French cities, famous in history for coronations, in legend for its jackdaw, in commerce for its champagne, has seen spectacles recalling the prophetic vision of H. G. Wells and Jules Verne. The sight of half a dozen flying machines in the air at the same time has provoked newspaper scribes to rhapsodies quite excusable. The accounts of "indescribable emotions" evoked by the aerial evolutions of the "heroes" of aviation will incite keen interest rather than derision; for it is all truly wonderful, beyond the measure of adjectives. At Rheims (which should be pronounced like the French word *rince*) the flimsy craft of aeroplanes were seen emerging from their *hangars*, like swallows from a nest, sweeping and swaying in the still air of the twilight, or soaring in the sunshine while their shadows glided over the hayfields of Bétheny. Is it any wonder that those who were privileged to be present were excited, for does it not appeal to the poetry lurking even in the materialist; is it not the veritable romance of engineering? The civilised world looked on from a distance and thrilled with expectancy. The intoxication of being in the air has seized the modern mind and man exults in having wrested from the birds their secret. Already the engineer has learned how to control the direction of his flight and has achieved a speed vying with the fastest train or automobile. Limitations have been swept aside; it is said that birds have been known to fly 180 miles per hour; already aviators talk of covering 200 miles in the same time. The mechanical bird seems destined to cross the Atlantic in less time than our grandfathers travelled in a stage-coach from London to Liverpool; the winged ferries of the sky will yet make the passage from Europe to America between one sunrise and another. From a hop of a few feet to flights of over a hundred miles, the flying man has now soared confidently in resolute defiance of supposed laws tying him to the earth. We may expect that as the utmost resources of mechanical genius are fully utilised man will pass the eagle in the air as he has proved himself fleeter than the other denizens of land and sea; for does not the motor-car outstrip the Arab steed and the plumed ostrich, and does not the swift keel of the naval 'scout'



The Bleriot Aeroplane starting to cross the English Channel on July 25, 1909. Reproduced by courtesy of 'Flight.'

cleave the water faster than any fish? The day will come when the train will be as the stage coach, the motor-car as a suburban omnibus, and the horse an anachronism; we shall fly as Blériot, Paulhan, and Wright: we shall be as excited as the spectators at Rheims, and like them, the only thing to bring us to earth will be our hotel bill.

Smelting of Fine Sulphide Ores.

E. D. Peters, in the *Mineral Industry*, Vol. XVII., discusses at some length the problem of smelting fine sulphide ores in the blast-furnace. His paper is prompted by the success of sintering by pot-roasting, which is described by H. F. Collins elsewhere in this Magazine. By means of this process it will be possible not only to prepare a sintered product suitable for smelting in the blast-furnace, but also to evolve a new process consisting of a compromise between coke smelting and true pyrite smelting that will treat mixtures of dry silicious precious-metal ores and heavy pyrite concentrates. The concentrates contain heat and basic flux, but these advantages have hitherto been neutralized by the physical condition of the concentrates. By means of pot-roasting the iron pyrite may be agglomerated, and the heat required for roasting may be obtained mainly from the volatile atom of sulphur in the FeS_2. This atom has no fuel value in pyrite smelting, so that the sintering process does not interfere with the fuel value of the ore in the blast-furnace. The agglomerated ferrous sulphide will form the nucleus and basis of the blast-furnace mixture. It will furnish the FeO necessary to keep the proportion of that base in the slag up to a minimum of 20% or whatever standard experience dictates, and will contribute, in conjunction with the sulphides contained in the dry silicious ores, an important proportion of the heat required for smelting the mixture. The presence of 15 lb. of copper per ton of the mixture will be sufficient to collect the precious metals. The amount of coke required will be from 3 to 6% of the charge, according to the amount of FeS present; though with slags low in iron and high in silica and alumina, as much as 8% might be required. An average slag would contain 45% SiO_2, 20% FeO, 10% Al_2O_3, 5% ZnO, and 20% CaO, MgO, etc. A large high furnace with moderately hot blast and high pressure should be used and careful bedding of the dry ores will be essential to uniformity of action. Like all Dr. Peters' contributions, this discussion should be studied in detail.

What is a Mineral?

The definition of the word 'mineral' continues to be a bone of contention in English legal and official circles. It is only a year ago that the courts were occupied for days discussing whether 'china clay' was a 'mineral,' and the disputants floundered lamentably for lack of an acceptable definition of the word. In Parliament there is the same doubt as to what is to be included among the "ungotten minerals," which it was intended to tax when they add to the value of the land. In July a case was heard in the Chancery division before Mr. Justice Swinfen Eady, in which the holders of mineral rights brought an action against the surface owners because the latter had excavated clay and sandstone in the course of building operations. It was not alleged that the defendants had disposed of the clay and stone at a profit, but the plaintiffs claimed that the substances were of value and could have been sold for brick-making and building purposes. Evidence was brought forward by the defendants to show that the stone was valueless for use in building and that the clay was so full of pebbles as to preclude its economic use in brick-making. The judge found for the defendants, holding that in law generally and in the special contract in this particular case, a 'mineral' is any substance in the earth's crust that gives the land a value over and above its agricultural or building worth. He reviewed at considerable length the various decisions given previously. This judgment will probably be referred to often in future arguments, as it deals with what may be called the limiting case. The occasion is opportune to point out once more the confusion that arises from the misuse or loose use of technical terms. 'Mineral' has more different meanings than any other. To the geologist, it signifies a constituent of the earth's crust that has a definite form and structure and cannot be separated mechanically into other constituents. To a biologist, a mineral is anything in nature that does not belong to the animal and vegetable kingdoms. In law, a mineral is a substance that gives land a value distinct from its surface value. Prospectors refer to a mineral as a valuable compound of a metal occurring in a vein.

Iron and Steel Industry in the Transvaal.

Whatever the difficulties that may have to be encountered by the future pioneers of the iron and steel industry in the Transvaal, the public assurances recently offered should remove all fear of Government apathy or lack of popular support. The 'ground possibilities' of this industry have lately been the basis of several influential pronouncements, to say nothing of enthusiastic Press opinions and discussions. Sir Thomas Price, in an address delivered—as honorary president—before the Transvaal Institute of Mechanical Engineers, referred to the initial step now being taken by the Government and railway administration, of erecting a small smelting plant at Pretoria for experimental purposes and for using up scrap iron and steel. Again, in his inaugural address as president of the Chemical, Metallurgical, and Mining Society, A. McArthur Johnston dwelt briefly on the benefits of an iron industry to the country, before dealing in detail with certain interesting features of the crystallisation of iron and steel revealed by microscopic examination. Mr. Johnston pleaded that the question of the establishment of an iron industry, in its technical aspect, was one for the metallurgists to take in hand rather than the mechanical engineers. Unfortunately, the people most difficult to interest deeply in the matter are the financiers. The Government has expressed its readiness to hold out a helping hand in no mean spirit, as a memorandum drawn up by R. N. Kotze, Government Mining Engineer, has clearly indicated.

Mr. Kotze, in common with all who have studied the question, is in favour of the embryonic industry being fostered by State bounties on the system adopted by the Canadian Government. He also suggests the provision of a State guarantee of interest (5 per cent.) on the capital spent, for a period of five years. The bounty is provisionally fixed at 15s. per ton produced, with a reduction of 1s. 6d. per ton annually so that bounties are automatically extinguished in 10 years. It is proposed to ensure a monopoly for the company that, under conditions of acknowledged soundness, undertakes the risk of the initial undertaking. Clearly then, we see here a well advertised opening for capital, of good promise. At present, the country is only asking to have its iron ore and fuel and flux resources investigated by those who, if satisfied with results, are able to follow up their investigations by practical and productive operations. The best known occurrences of iron ore in the Transvaal are: (1) Enormous deposits of magnetite to the north of Pretoria, and at Magnet Heights in the eastern Transvaal. These are rich in iron—55 to 65%—but they contain a high proportion of titanium (10%), which has checked their development. (2) Irregular deposits of hematite to the south-east of Middelburg; these are pure but of doubtful quantity. (3) Ferruginous quartzite in the Pretoria beds, generally low in iron (40 to 50%). (4) Limonite beds in dolomite, assaying up to 40%, near Pretoria and elsewhere. (5) Chrome iron ore in "inexhaustible quantities" containing 40 to 50% chrome oxide. Good coking coal and suitable limestone for fluxing are not so readily available, but the existence of these necessaries like the metallurgical features of the ore deposits calls for thorough investigation before the prospect of the Transvaal iron industry can be determined with any confidence.

Titaniferons Magnetite at Onderstepoort, near Pretoria.

SINTERING OF COPPER ORES IN SPAIN

By HENRY F. COLLINS.

THE pot-roasting or blast-roasting of fine ore has now become an accepted part of the metallurgy of copper. At Garfield and other great American plants, where 8, 10, or 12-ton pots are employed, a costly travelling crane is an essential feature of the installation; and this, of course, necessitates a heavy and costly type of building to carry the crane. Such an installation has obvious advantages where a large tonnage has to be handled, but for a small smelter in any country where unskilled labour is comparatively cheap, and particularly in cases where the agglomeration of fine material plays but a secondary part in the economy of the plant, a much less costly equipment can be adopted and made to give good results.

At a plant in Spain recently designed and erected by the writer an ore composed chiefly of quartz sprinkled with chalcopyrite, with some admixture of calcite and of altered dioritic country rock, is concentrated; that coming from the richer stopes is treated by ordinary wet methods, that from the poorer stopes by magnetic separation after a preliminary roast. Each method of concentration yields: (1) A concentrate of 16 to 22% copper and (2) a middling with 6 to 12% copper. The coarse-jig middling might be smelted direct together with hand-picked rich ore, but the finer concentrates and middlings both from wet concentration and magnetic separation require agglomeration to put them in a suitable condition for blast-furnace smelting. From one part of the mine there is, in addition, a considerable output of somewhat more friable ore in which the sulphide mineral has been altered by secondary enrichment and carries in all its joints and crevices films of covellite or chalcocite, or both, so that by breaking the lode-stuff clean and screening it, dark fine material is obtained running from 8 to 15% copper, while the coarser pieces are picked out for direct smelting. The material for agglomeration then consists of *(a)* concentrates and middlings from both wet and dry concentration plants, carrying 12 to 18% copper as mixed, and *(b)* fine rich ore from underground carrying 8 to 15% copper.

Owing to the low percentage (not over 15%) of sulphur in the material treated, and to the comparatively high temperature of fusion, no previous preparation by preliminary roasting is necessary as in the case of lead ores. The fine stuff on hand is simply mixed in any convenient proportions, but as thoroughly as possible, being damped with a hose at the same time; the moist mixture is charged quite cold into a pot in which a small fire has been previously made, and blast is at once turned on. When the mixture contains a considerable proportion of jig concentrate and middling of over ¼-inch size, thus rendering it readily permeable by the blast, no other admixture is necessary in order to obtain a good furnace-product. The fine from the iron ore purchased as flux, however, is mixed with the ore previous to calcination, in proportion averaging about 5 to 6% of the weight of the ore; this serves the double purpose of assisting the agglomeration by slagging of silica, and of putting this fine ore into a more suitable condition for the furnace. When the charge-mixture contains a preponderating amount of fine below ⅛-inch size, so that a decided resistance is opposed to the passage of the blast, it is found advantageous to add a small proportion of coarsely crushed slag, which not only increases the permeability of the charge and so shortens the roasting time, but also facilitates agglomeration. The average proportion of slag used, however, does not exceed 3% by weight of the charge.

The pots are conical, like the original Huntington-Heberlein pots, but are made of wrought iron after the pattern of those used at Laurium for roasting lead ores, although the capacity is slightly larger. Fig. 1 shows the side and front views (half sectional) and plan; Fig. 2 gives details of the perforated grate and of the cast-iron wind-box. Except the pedestals and bearings, hand-wheels and perforated grate, which are of cast-iron, and the wind-box, which is of cast-steel, all parts of the pots and trucks are made of mild-steel.

Blast is admitted at the bottom through a 6-inch branch from an underground 18-inch main serving all the pots, connection being made from the T to the wind-box by means of an alum-soaked canvas hose, which can be disengaged in a moment by turning two wing-nuts. Each branch connection is furnished with a sliding gate-valve, but the available blast-supply being in excess of that required by the pots these valves are not always closed when not required. There are 10 connections for pots, but only 7 to 8 pots are at present in use. The fume is collected by means of hoods above each pot depending from a sheet-iron flue of 3-ft. diameter, which delivers first into a firebrick flue and thence into a square stack of ordinary red brick; the internal lining of both flue and stack is laid in a mortar composed of sand and boiled coal-tar, and all faces of the bricks are thoroughly soaked in coal-tar in order to protect them from the corrosive effect of the acid vapour. The iron hoods, downtake, and flue were thoroughly soaked in boiled coal-tar before and after the erection, and after 16 months' service show but little evidence of corrosion.

The capacity of each pot is from 3,400 to 3,600 lb. of silicious concentrate mixture, equivalent to over 2 tons of lead ore. Combustion is started when the pot is under the hood by throwing two shovelfuls of embers from a boiler fire; upon this is scattered a couple of shovelfuls of small coal. A light blast is turned on, and the burning fuel is covered with about a hundred pounds of ore-mixture, another shovelful or two of this being added if the blast should break through prematurely. After about 10 minutes blowing, the joint of the blast is broken and the pot is run back to the loading-platform, where the full charge of ore is rapidly shovelled in, and, after levelling off, the pot is again run under the hood, connection with the blast-pipe is made, and blast is turned on at a pressure of 7 to 8 oz. Care is necessary at first to prevent the heat from becoming too high at the bottom of the cone just above the wind-box, and, in fact, it is generally necessary to play a jet of water for a few moments on some portion of the iron where the heat becomes so localized as to make it red hot. In order to obviate the danger of burning the iron through neglect of this precaution, an open jacket of sheet-iron has been subsequently fitted round the lower part of each pot, with an asbestos joint against the lower flange where the wind-box joins on. Water is simply poured into this on turning on the blast and generally requires no replenishment, since after the first 20 minutes there is little or no danger of burning. It is advisable to punch a number of holes all round the top of the charge with a long poker in order to ensure an even distribution of the air-currents, and consequently of the sintering process, each being choked in turn as it shows signs of becoming a blow-hole. Towards the end of the operation the blast-pressure rises to 12 or 13 oz. per square inch.

With a considerable proportion of material of $\frac{1}{8}$ to $\frac{3}{8}$-inch size the sintering operation can be easily completed in 6 to 7 hours, but in the absence of coarse material it takes longer; thus when all the charge passes a $\frac{1}{2}$-inch and nine-tenths of it a $\frac{1}{8}$-inch screen, from 9 to 10 hours at least are required for thorough sintering. By means of the worm gear one man readily inverts the pot and the sintered mass usually comes out in a lump before the edge of the pot reaches its lowest point. Around the sides of the pot, and occasionally also toward the centre, may be found some material that is imperfectly roasted and not sintered, but with due care, and when the pot-charge runs sufficiently high in sulphur and low in silica, this unsintered portion need not amount to more than 5 to 10% of the charge. When, however, exceptionally silicious material low in sulphur is treated, the proportion of unsintered fine stuff rises to as high as 30% and may average 20 to 25%; this, in any case, goes back and is mixed with the charge for another pot. The lump of sintered material is not so hard but that it can be readily broken up, first by means of wedges and sledges, and afterwards with picks, into convenient lumps from the size of a man's head downward; these are loaded into ordinary tipping wagons and taken away to the bins holding the calcined ore, the fine produced in breaking being loaded together with the lumps. The material, being intermediate in physical condition between coke and boiler-clinker, is in ideal condition for blast-furnace treatment, and so low in sulphur as to ensure the production of a high-grade matte (above 60%) when mixed with a much smaller proportion of hand-picked rich ore. Analyses of the various classes of material to be sintered are given below together with two analyses of sintered material, one being the product ordinarily made, and the other a silicious product made from a mixture of magnetic middling and crude fine ore alone, without any admixture of concentrate; this sufficiently illustrates what can be done under favourable circumstances in sintering silicious material.

Each of the samples quoted is fairly representative, being an average of one month or of several, but the roasted products do not represent exactly the same periods as the

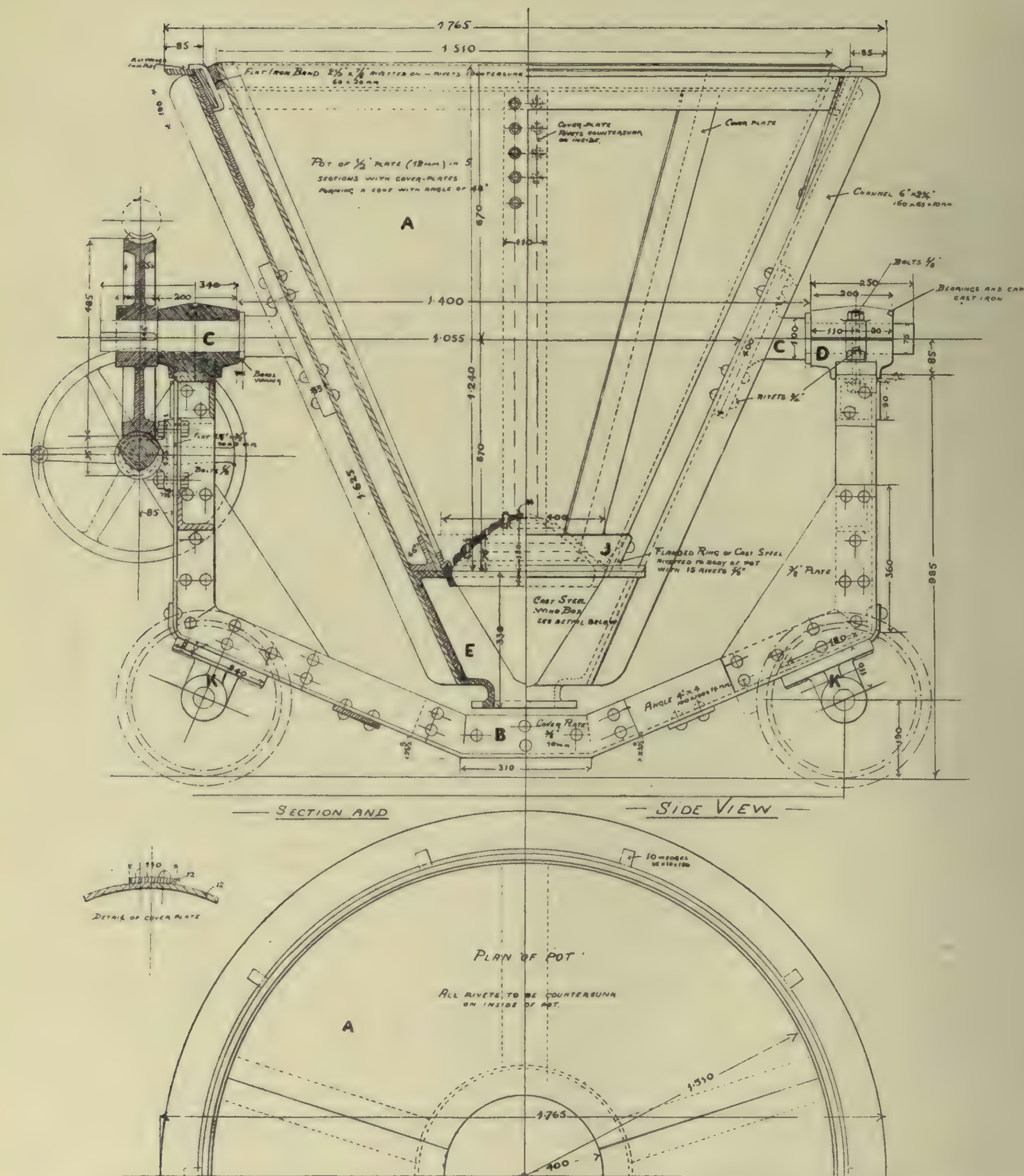


Fig. 1. Sintering of Copper Ores.

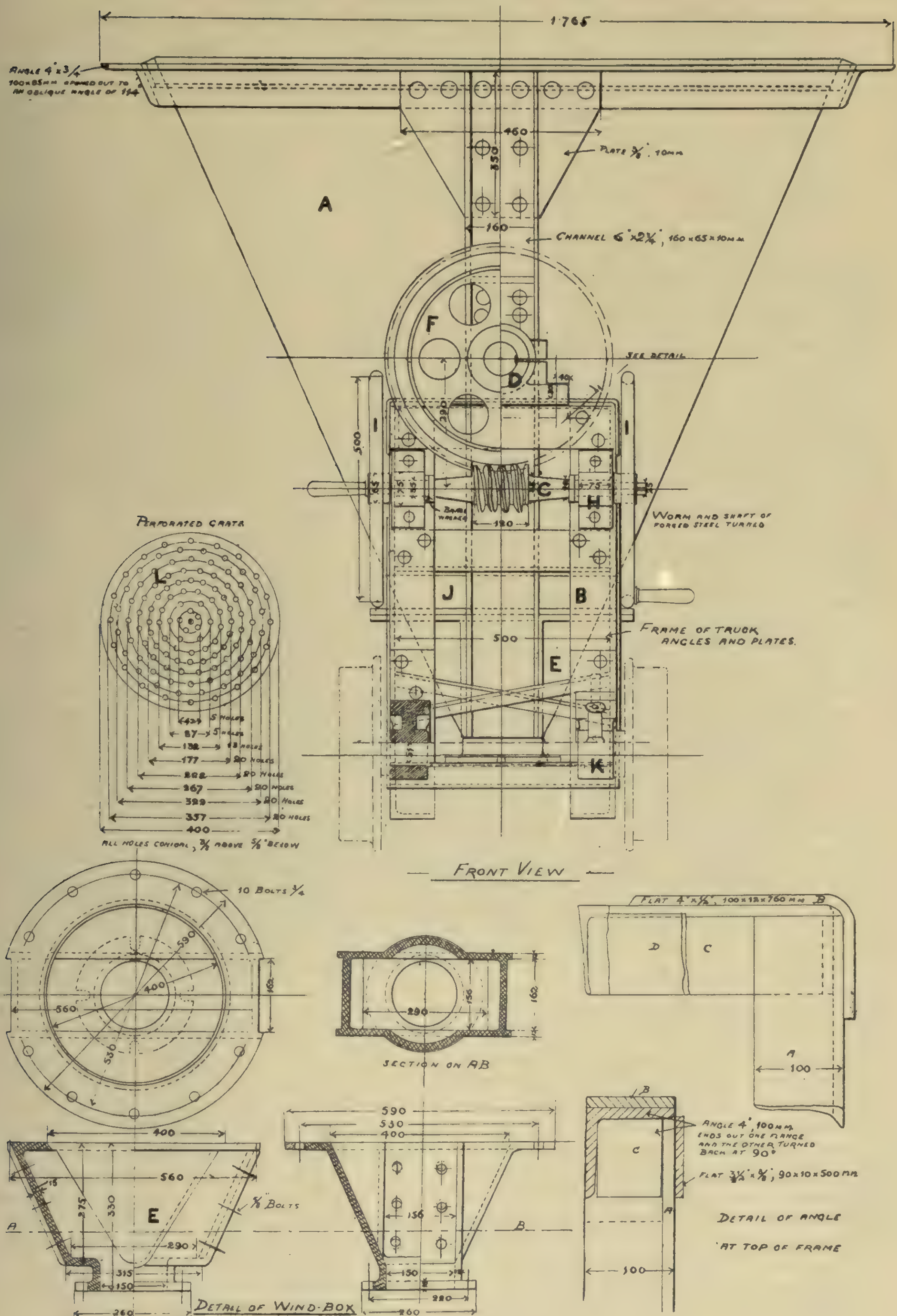


Fig. 2. Sintering of Copper Ores.

	Magnetic Concentrate	Magnetic Middling	Wet Dressing Concentrate	Wet Dressing Middling	Crude Fine	Sintered Product Ordinary	Sintered Product Exceptional
Insoluble ...	25·0	50·7	23·0	41·6	60·2	45.5	56·2
Fe ...	22·3	5·6	24·2	16·7	6·8	18·1	9·8
MnO ...	0·4	0·3	0·4	0·3	—	—	0·2
CaO ...	2·4	6·5	2·8	3·4	4·2	7·8	6·5
MgO ...	0·4	1·0	—	—	—	—	1·2
Al_2O_3 ...	4·2	5·2	—	—	4·7	—	7·1
Cu ...	20·0	9·3	18·6	10·2	12·5	14·1	7·7
S as sulphide	12·8	6·0	27·8	15·2	7·0	—	2·0
SO_3 ...	3·3	2·8	nil	nil	nil	—	1·4
Total Sulphur	14·2	7·1	27·8	15·2	7·0	5·3	2·6

raw materials, hence the proportions of lime and alumina show some discrepancy.

Blast is supplied by means of a blower much larger than is necessary for the number of pots in use, the surplus air being allowed to escape; this, of course, involves but little waste of power. The principal item of cost is that for labour, mainly for breaking and loading the sintered masses. The battery of 7 pots is worked on 8-hour shifts by 4 men per shift, and each shift is expected to charge, blow, and dump each of the pots, separating any unroasted material, breaking the sintered mass, and tramming the product to the smelter-bins. This should mean the charging, on each shift, of 12 tons of material, but as some charges take longer to finish, while others contain a certain amount of unroasted material that has to be returned, the average output is only about 4 tons per pot per day. These figures refer to the ordinary material containing more than 10% sulphur and 15% iron, the output falling off considerably when the mixture contains a high proportion of crude silicious fine low in sulphur, so that when the proportion of silica in the average charge rises to 53% the output is reduced to 15 to 18 tons per day, or 2½ to 3 tons per pot.

The daily cost for labour is about 1·75 pesetas per ton, or, at present exchange, 1s. 2d. per ton. To this may be added at the outside 3½d. per ton for power, for the blast, and for tools, making a total of under 1s. 6d. per ton. Allowance has not been made in these figures for repairs and renewals, inasmuch as the plant has not been working long enough for these factors to be determined with accuracy, but the amount will be, in any case, quite low. In a large pot-roasting plant using crane-handled 10-ton pots the cost under Spanish conditions could be easily brought under a shilling per ton. The total cost of the installation ready for work was under £1,000, which at 10% for interest and depreciation represents about 2½d. per ton.

Experiments have shown that when mixed thoroughly with a considerably greater amount of raw concentrate fairly high in sulphur, especially when containing a good proportion of coarse material such as jig concentrate or middling, flue-dust can be satisfactorily agglomerated by this method. The great advantages offered is that of putting into ideal shape for the blast-furnace any kind of fine sulphide ore and concentrate within wide limits of composition, thereby eliminating the necessity for using reverberatory furnaces, the expenses of which for fuel and repairs are in many districts so high as to raise their total running costs far above those of the blast-furnace. Another important advantage is the elimination of 50 to 65% of the sulphur present in the charge, whereby the matte produced on subsequent smelting in the blast-furnace instead of containing somewhere about 30% copper, as it would if the fine ore were simply melted down in a reverberatory, is raised at once to above 60% copper; the cost for fluxing being at the same time reduced in consequence of the utilization (as flux for the silica) of the iron released from its combination with sulphur. In no way can sulphur be expelled from fine material so cheaply as by blast-roasting; and the raising of the grade of the matte produced, with the consequent economies effected in freight and treatment charges (and, in the case of Spain, in export duties), will in most cases amply justify the adoption of this method, quite apart from its other advantages.

Steel.—The first serious attempt to manufacture steel west of the Rocky Mountains is being undertaken by the Irondale Steel Co. of Seattle, Washington. The company recently built a blast-furnace at Irondale, near Port Townsend, Washington. The additional equipment now being erected consists of two 20-ton open-hearth furnaces and three rolling-mills. The plant when complete will have a yearly capacity of 21,000 tons of pig and 45,000 tons of steel.

METALLURGY ON THE RAND

By T. LANE CARTER.

AFTER a residence of nearly a dozen years in South Africa, I have been travelling over the American continent, with a frequent glance backward to the Rand, the inevitable result being that the metallurgical methods once at my elbow look quite different when viewed at a distance of ten or twelve thousand miles. If you stay in the Transvaal long enough, you are liable to grow into the habit of thinking that finality has been reached in cyanidation, and that nothing could be better than the practice prevailing at Johannesburg. Much may be learned by the comparative method; therefore a few reflections that have come to me in contrasting Rand metallurgical practice with that of other districts may prove suggestive.

Superimposed sand-treatment vats of the Village Deep Mine.

In the first place, I have been impressed repeatedly by the extreme simplicity of the 'banket,' compared with the ore of other districts, from the cyanider's point of view. The man who has obtained his knowledge of cyanidation on the Rand, and has not kept in touch with the work done in other parts of the world, is liable to get into trouble when he accepts a position as cyanide expert in a locality where the conditions are entirely different.

I noted a concrete example of this in Central America not long ago. A cyanide man, who had learned all he knew about the process on the Rand, accepted the position of metallurgist at a mine in Nicaragua. In less than a month he was in a helpless tangle and left in disgust, convinced that it was impossible to cyanide successfully the residue from a particular stamp-mill. Then a man who had had a varied experience in cyanidation both in the Western States and Mexico took over the plant, and soon changed a considerable loss into a substantial profit. A purely local training in a specialty like cyanidation is dangerous to a mill-man unless he intends living and dying in the same district. The remedy is to keep in touch with what others are doing elsewhere.

What is suitable in the Transvaal may be detrimental elsewhere; for instance, the use of lime in the stamp-mill. On the Rand it is customary to spread lime over the ore in the bins, and to watch the alkalinity closely. This scheme was tried once at the Homestake mine, in South Dakota, with unfortunate results, for a hard crust formed over the plates, so that amalgamation nearly ceased.

The amalgamation practice of the Rand leaves little room for criticism. The scheme of discarding this time-honoured method of catching gold is revived perennially; the usual alternative is crushing in cyanide solution; this is tried at a huge expense in one or two mills and is then buried for a year or so, until there is a dearth of subjects for discussion, when out comes the proposition again to crush in cyanide solution. For an ore as simple as that of the Rand, I believe the method of amalgamation with subsequent cyanidation of the tailing is the best. Crushing in cyanide solution may be the ideal process in some parts of the world, where little or no gold can be caught by amalgamation, but I believe it would be a big mistake to discard amalgamation on the Rand.

Contrast the ore of the Rand, where an extraction of 50 to 60% is obtained by plate amalgamation, with an ore I saw at a mine in Nicaragua a few weeks ago: The owners were about to despair of the mine, because they could extract little or no gold by stamp-milling and amalgamation. Experiments made on ore that had been crushed between rolls in a strong cyanide solution, showed that by this treatment the ore would yield a large profit. By sorting it is possible to raise the grade of this ore to a value of $47 in gold and 11·6 oz. silver per ton. The vein is in an andesitic country, and consists of galena, pyromorphite, chalcopyrite, marcasite and sphalerite. By grinding through a 60-mesh screen and consuming 6½ pounds of cyanide per ton treated, it is possible after 9 hours' agitation to get an extraction of 94% of the gold and 70% of the silver. This ore, unlike that of the Rand, required crushing in cyanide solution.

The enormous capital expenditure on the metallurgical plants of the Rand compared with other gold reduction works affords one of the most striking contrasts between the Transvaal mines and those of other countries. The raising of money in the past on the Rand has never been the same problem as in other districts; in consequence, money has been spent more lavishly there, both on the surface and underground, than in places where money was harder to get. I am impressed by the large capital expenditure on the mines and plants of the Rand, compared with other countries.

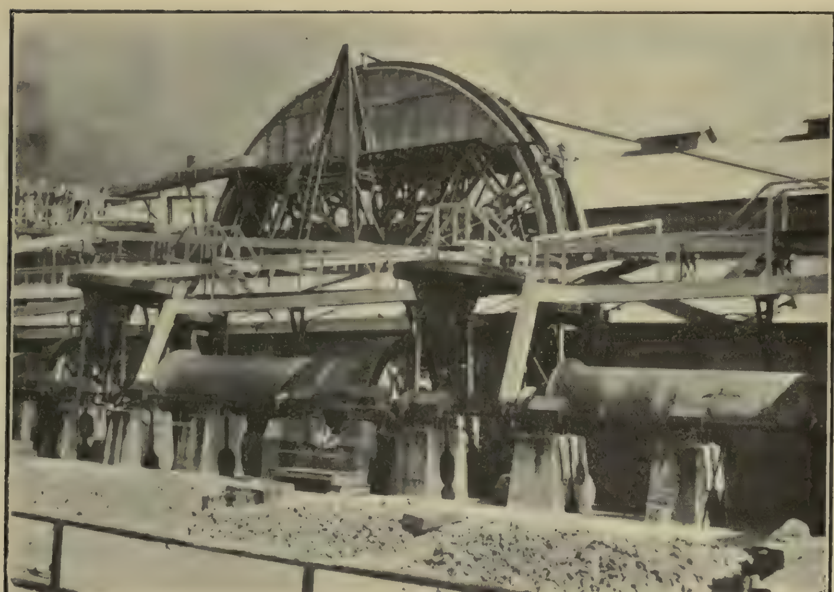
The scheme of double-tier steel vats in the cyanide plants is adversely criticised by metallurgists in America, who point out the large extra expenditure of money due to the super-imposed vats. The American metallurgists do not see the need for double treatment. They claim that if care be used in the filling of the vats, so that no slime is allowed to settle with the sand, and if compressed air be used when required, the double-tier vat can be discarded and single treatment used in place of double treatment.

The practice at the Homestake mine shook my faith in the superiority of double treatment. At the Homestake, the sand (separated from the slime) is run into a 55-ft. vat, an automatic distributor being used. Now, instead of going to the expense of taking out all this sand and dumping it into another vat for treatment, the sand is treated in the same vat in which it is caught. On account of the ferrous state of the iron, compressed air is used before treatment. Single treatment is undoubtedly cheaper both in capital expenditure and working costs. In most places in the United States, as well as in Central America, the double-tier vats are unknown, and good results are obtained by a single treatment. However, in using the single treatment, care must be taken to see that a sand free from slime is caught in the vat. The method of filling the vat with hoses, and allowing the slime to run off through side gates, so common on the Rand, is not at all popular in American and Mexican mills. Automatic distributors are preferred, even in vats of 55-ft. diameter, as at the Homestake.

On the Rand only a cocoa-nut matting is used at the bottom of the sand-vats. In America, it is customary to spread duck over this matting, and to tighten it with rope driven around the periphery of the vat. This makes an excellent filter.

The decantation process of slime-treatment is almost universal on the Rand, and as it was entirely developed there, the men of Johannesburg are proud of it, and stand by it. At one time I thought it was the one and only process for treating the slime from the banket. Now, I am not so sure of it. Where the process has been installed, it should not be disturbed, of course, but if a new slime-plant were to be built to-morrow, I would like the designers to consider the filter-press methods now adopted in the United States and Mexico.

Blaisdell Sand-Distributor at the Robinson.



Tube-mills of the Village Main Reef.

The Rand decantation process has not been welcomed in other parts of the world. At one plant in Central America I saw it used, but with poor results. Some form of filter-pressing is employed in the treatment of slime in almost all the mining centres of America. The Rand appears to be the only place where filter-pressing in the treatment of slime is not used on an extensive scale. Filter-presses have been tried in the past, and at one or two plants are still being used, I believe, but so far their use has not become general. It is my opinion that a mine on the Rand putting up a new slime-plant would make an improvement by erecting some form of filter-press, either the Butters, the Moore, or the Merrill machines, discarding the decantation process. I do not think as much of the decantation process as I did once, for I have seen a good many plants since I left South Africa.

The Homestake slime is treated in 26 Merrill presses, holding 25 tons of dry slime each. The extraction is 85% on slime, assaying 86 cents in gold (a far poorer product than that of the Rand, which will go from \$1·50 to \$2·50) at a cost of 25 cents per ton treated. The initial expense of putting in the Merrill presses should not be any higher than for the decantation process. Now that there is a strong committee on the Rand to investigate such matters, it would be a good scheme, it seems to me, to look into the merits of the three filter-press methods already mentioned, and prove by extended trials whether the devices used in America to-day would not be preferable in future plants for the treatment of Rand slime.

The use of zinc-dust for precipitation, instead of zinc-shaving, is another noteworthy difference. In some of the large plants in the United States and Mexico, the zinc-dust method has entirely superseded the precipitation by zinc-shaving. In the smaller plants, of 50 to 100 tons daily capacity, the zinc-shaving method is used in preference to zinc-dust.

There is one mechanical error sometimes made on the Rand, namely, to supply the cyanide-plant with power through the mill-engine. This means that at times the mill-engine is run for the sake of a small pump in the cyanide-plant. It seems to me that power for the cyanide-plant should be supplied from an electric generator driven by an independent engine, and not from the mill-engine. In some of the out-of-the-way mines I have noted, with interest, the use of gasoline furnaces for smelting and in the assay-office. In Central America the furnace made by F. W. Braun, of Los Angeles, is often seen and is doing good work. Without this contrivance assaying in these remote localities would be nearly impossible, on account of the prohibitive price of coke. With the Braun furnace, gold assays can be done satisfactorily, even in the wilds, for 7 to 8 cents each. These gasoline furnaces can do good work in the assay-offices on the Rand, and should be tried on a working scale.

I note the tendency, both in America and Africa, of reducing the timber used in reduction plants, substituting steel. In the West, they have gone further than on the Rand, and some mills have their king-post made of steel. In a plant that is expected to last 25 years or more, it pays to put in steel wherever possible, especially when timber is as expensive as it is in South Africa.

Arkansas Diamonds.—The discovery of diamonds in Arkansas was made in August 1906, by J. M. Huddleston, the occupier of land in Pike county. He took two stones, one of which weighed 4½ carats, to a jeweller at Little Rock, who with friends secured an option on Huddleston's property and formed the Arkansas Diamond Co. The volcanic rocks in the neighbourhood have been known for seventy years and suspected of being an original matrix of diamonds. The operations of the diamond company have so far been confined to experimental tests at various parts of the peridotite pipe, but as the washing plant is crude, no reliable information is yet to hand. Up to the end of 1908 the number of diamonds found was 540, of which 505 averaged half a carat; the largest weighed 6½ carats. With systematic treatment of the ground, more reliable information will be obtained.

Tin.—The yield of tin from the alluvial deposits of Cornwall has been estimated by J. H. Collins, who calculates that between the years 1200 and 1800, no less than 550,000 tons of metallic tin were obtained from the streams alone, which never contained even in their richest parts as much as 1% of metal.

At Ducktown, Tennessee, black copper ores of secondary origin are found abundantly in a narrow zone below the gossan and above the original pyrite. In the gossan large masses of oxide of iron have been found and mined.

THE HISTORY OF THE FLOTATION PROCESSES

OWING to the fact that litigation has necessarily sealed the lips of engineers and scientists interested in the various flotation processes used in the concentration of ores, comparatively little reliable information has ever been published relating to the history of the various methods tried or proposed. The lawsuits are not yet at an end either in this country or in Australia, so that the public discussion of the practical details is still postponed. From another point of view it may be said that such details as have appeared in print are incomplete and one-sided, having for the most part been inspired by rival patentees. Then again little has been recorded relating to unsuccessful processes; yet, in their influence on subsequent inventors, such processes have been of no small importance.

A flotation process is one in which the metallic or sulphide constituents of an ore are caused to float on the surface of a liquid by the instrumentality of one of three agencies, namely, oil or similar matter, bubbles of gas, and surface tension, or by a combination of two or all three of them. As regards the action of oil, it is to be noted that it is utilised in two ways, one being to lift the metallic particles and sulphides bodily against gravity, while the other is simply to agglomerate the particles into a mass that can be floated by bubbles, or otherwise collected. Also it has to be remembered that the power of oil to so collect the metallic or sulphide particles was originally proposed in connection with processes in which flotation played no part.

In studying the history of these processes it is difficult to reconstruct the evolution of the discoveries, and to follow the thoughts and opinions of the inventors. The causes of the various phenomena noted in the processes were incompletely known at the time of their discovery, and the explanations of them that can be given now with the aid of subsequent additional knowledge are rather apt to confuse the issues between the various rival inventors. We propose therefore to give a short discussion of the various patents, which have formed the landmarks, so to speak, of successive discovery and application.

The first reference to the practical application of the so-called 'selective action' of oil is found in British patent No. 488 of 1860. In this patent William Haynes, of Holywell, Wales, describes a process in which an 'agent' consisting of a mixture of fatty or oily matters, coal tar, gum, etc., is kneaded into the ground ore in the proportion of one part of 'agent' to from 5 to 9 parts of ore. The pasty mass is afterwards removed to a triturating machine and covered with water. The gangue is here gradually separated and washed away, and further supplies of ore are added until the 'agent' will take up no more sulphides.

The next are the United States patents granted to John Tunbridge of Newark, New Jersey. The first was filed on December 7, 1877, and issued September 3, 1878, the number being 207695. The object of this invention is to collect 'float' from waters used by jewelers in washing their hands. The waters are passed through a hydrocarbon, which, together with the soap, collects the valuable particles. The second is numbered 228004, it was filed on November 4, 1879, and issued on May 25, 1880. This is an amplification of the former, and, in addition to jeweler's waste, a specific mention is made of miner's water containing 'float.' The inventor adds a soap solution, which, if the water be hard or salty, will form a coagulum that catches the metallic particles and forms a froth, which can be skimmed. If the water be soft or alkaline, the inventor adds a roasted sulphate of lime or some acid.

Next comes the Carrie Everson patent, which has loomed so large in recent litigation. This is an American patent granted to Carrie J. Everson of Chicago; it is No. 348157 and was issued on August 24, 1886. The inventor mixes oil and acidulated water with the crushed ore to make a stiff paste, kneads it well to get the oil and acid into contact with all the particles of the ore, and then washes the mass with water, stirring all the time. In this way the gangue is washed away, leaving a mass of metal or sulphide behind. The process is not dissimilar to Haynes's, as described above, but differs in the fact that oil is used instead of a complex 'agent' and also that the addition of acid is specifically mentioned. It is difficult to decide when reading the specification whether the process was intended to be continuous or not. It is in fact this very point that has caused so much discussion in the law courts.

This process was subsequently apparently modified, as is proved by a reference to the *Engineering & Mining Journal* of November 15, 1890. In this paper a special correspondent describes a test of the Criley & Everson process, as made at Baker City, Oregon. Crushed ore was mixed with thick black oil and then hot acidulated water added, the sulphides thereupon rising to the top as a scum. The information available is meagre and the article is hardly legal evidence, but to the lay mind it serves to indicate that flotation by oil, acid, and gas, as applied to ore concentration, was not entirely unknown in those days.

Another reference in patent literature to the collection of metallic particles by oil is to be found in British patent No. 24144 of 1892, in which J. W. Sutton of Brisbane describes a process for collecting, by means of a hydrocarbon oil, the fine particles of gold precipitated from the solution of gold chloride obtained in the chlorination process.

Efforts were made in 1894 by George Robson of Dolgelly, Wales, and Samuel Crowder of London, to utilise the oil effect. Their process is described in British patent No. 427 of 1894. The inventors use an agitating vessel into which the ground ore is introduced in a moist state with no great amount of water. Through this vessel is made to flow a continuous stream of mixed hydrocarbon oil and fatty oil; these collect the metallic or sulphide particles and carry them to a settling-chamber. Here the particles are allowed to subside and the mixture of oils is drawn off for repeated use. It will be noted that the inventors use no more water than is necessary to moisten the ore.

We now come to what may be called modern times, when the oil effect was for the first time introduced on a practical scale. In 1898 Frank Elmore took out his British patent No. 21848. In this process not only was the collective power of the oil utilised, but sufficient oil was employed to lift the metallic particles or the sulphides to the surface of the emulsion. The separation of the oil and sulphides from the gangue and water was effected by centrifugal force. As far as undisputed records go, this process was the first continuous one. In British patent No. 6519 of 1901, A. Stanley Elmore claimed the use of acid in conjunction with the oil, pointing out that the attachment of the oil to the metallic particles was increased thereby.

The next patent in order of date is that of Alcide Froment, of Traversella, Italy, No. 12778 of 1902. This is often called the Lake, because the application for the patent was made by a patent agent of that name, but it is better to associate it with the actual inventor's name. This patent is notable as being the first to mention the use of gas for increasing the buoyancy of metallic or sulphide particles agglomerated by oil. The inventor directs attention to the fact, already known, that when powdered sulphides are moistened by a fatty substance they have a tendency to unite in spherules and float on the water. This tendency is retarded by the specific weight of the mixed oil and sulphides and also by the opposing action of the accompanying gangue. He proceeds to say that if gas of any kind be liberated in this mass, the bubbles of the gas become covered with an envelope of sulphides, which then rise more readily to the surface. He says that the formation of these metallic spherules is singularly active if the gas be in a nascent state. As examples of the process, he mentions an ore consisting of pyrite, dolomite, and calcite. If to the pulp be added a suitable quantity of oil and sulphuric acid, the liberated gas carries the collected sulphide to the top rapidly. It will be seen that this process is similar to that described in the *Engineering & Mining Journal* in 1890.

In British patents No. 26295 of 1902 and 18589 of 1903, A. E. Cattermole of London described a process in which a small amount of oil together with an 'emulsifier,' consisting of soap and alkali, are used. The function of this mixture is to agglomerate the metallic or sulphide particles into small masses that will be heavy enough to sink. The object of the process is to collect float material and give it sufficient weight to enable it to be separated by any usual method, such as on a concentrating table. Cattermole also took out the patent No. 26296 of 1902. This deals with mixed sulphides that have been separated from a gangue by any oil process. He finds that the addition of soap and alkali solution will release from the oily mixture such constituents as are least amenable to the oil effect. By passing the mixed concentrate into a series of spitzkasten containing a gradually increasing content of soap and alkali he separates from each other all the constituents of the concentrate.

Subsequently Cattermole, in conjunction with Sulman & Picard, brought out a process described in British patent No. 17109 of 1903. Here a small quantity of soap and acid is added to the pulp. The fatty acid liberated agglomerates the sulphides, which may then be extracted in any suitable way, but the inventors recommend that bubbles of gas should be generated by an excess of acid and the presence or addition of carbonates, so that the bubbles may carry the sulphides to the surface.

In a subsequent patent, No. 20419 of 1903, Sulman & Picard mention the use of ordinary air for the purpose of providing bubbles. According to this patent, the oil is brought into contact with the pulp in a vaporised state and is introduced by means of a current of air or other gas, which also serves to supply the bubbles required in flotation.

an incomplete vacuum. Patent No. 17816 claims: "In processes for separating certain constituents of finely divided material by causing them to rise or float in a liquid, conducting the process wholly in part under a pressure less than that of the surrounding atmosphere." The subsequent patent, No. 29282 of 1904, relates to the form of plant for carrying out the invention. The separation of the sulphides from the gangue agglomerated by oil and buoyed by rarified gas and air is effected by a continuous siphoning apparatus, containing a vacuum-chamber at the top.

So far we have discussed only those pro-

The mixers.

The vacuum-chambers.

Vacuum-oil concentration plant at the Sulitelma copper mine, in Norway.

The Sulman-Picard-Ballot patent No. 7803 of 1905 specifies a small amount of oil and acid. Less than 1% of an oily substance, such as oleic acid or petrol, is added to the acidified water and ore. The mixture is agitated to make a froth, which collects the metallic particles or sulphides and floats them.

The original Elmore process was subsequently superseded by an improved form, which is described in British patents No. 17816 of 1904 and 29282 of 1904. These patents cover the methods now in use and known as the 'vacuum' process. This utilises any of the flotation processes under

cesses in which oil or similar substances are used, and we pass now to those that contain no mention of oil. In 1902 C. V. Potter of Broken Hill found that if sulphide ores were placed in a solution of sulphuric acid and the whole heated to near the boiling point of the solution, the sulphides would rise to the surface and could be skimmed. The strength of the sulphuric acid solution is given as from 1 to 10%, or an average of 2½% for ordinary Broken Hill ores. The heating is preferably done by the introduction of exhaust-steam from the engines. The British patent is No. 1146 of 1902.

Following shortly after this patent, G. D. Delprat, of the Broken Hill Proprietary mine, patented his process, which is similar to that of Potter, the difference being that the former uses acid sulphate of soda instead of sulphuric acid. Subsequently Delprat took out patents No. 19783 of 1903 and 27132 of 1903. The first-named is an amplification of the original one and the second covers the use of a solution produced by adding sulphuric acid to a solution of common salt. Though it is well known that the Potter and Delprat processes depend on the buoyancy of bubbles generated by the reaction of the solution on the ore, no mention of this fact is made in the specifications.

A third group of flotation processes are founded on the principle of surface tension. It has been known from time immemorial that particles or even large pieces of certain classes of heavy minerals or metals will float on the surface of water if placed there in a gentle way, more especially those substances that refuse to be wetted by the water. Here again the question of the presence of oil comes in, for a greasy metallic surface is more likely to float than any other. At the time when other flotation processes were coming to the fore, A. De Bavay of Melbourne proposed to make use of the flotation by surface tension for separating zinc-blende from gangue. His British patents, No. 18660 of 1904 and 25858 of 1904, describe his process and plant. The finely crushed ore is delivered as a thin layer of pulp down a gentle slope on to the surface of still water. The sulphide remains on the surface of the water, while the gangue falls through. The specification also deals with sulphides that have been partly oxidised and shows how to remove the carbonate adhering to the surface before the ore goes to the concentrator. The plan preferred by the inventor is first to agitate the pulp with carbonic acid gas and then draw off the soluble bicarbonate thus formed.

Another surface tension process is that of A. P. S. Macquisten, of Glasgow. According to his British patent No. 25204 of 1904 he first immerses the whole of the ore in water and then gradually brings it to the surface on belts or otherwise. When passing through the surface the sulphides float and the gangue afterwards falls once more. In another patent, No. 25204A of 1904, he describes a process in which the ore is carefully brought to the surface of water from above and the gangue caused to pass downward by a concussion of the machine. Macquisten finally comes within the oil-effect division of flotation processes by describing in British patent No. 15119 of 1905 a modification of the process forming the subject of patent No. 25204A whereby he adds soap and a water-hardener in small amount so as to improve the flotation action.

It will be seen from the above dissertation that the three factors in flotation, namely, the oil effect, the gaseous effect, and the surface-tension effect, overlap considerably. Many processes specifying only one or two, may consciously or unconsciously be using two or three. It is not proper for us to discuss the details from this point of view at the present moment, seeing that the matter has not yet been completely threshed out in the courts of law. Neither do we desire to discuss the physics of the phenomenon of surface tension of oily metallic surfaces as observed in the adherence of gas bubbles to such surfaces. Complete studies of this subject have been made by metallurgists, who may decide later to publish their views and conclusions. Another aspect of the question caused, at one time, no little discussion, but it is now removed from the domain of research. We refer to the confusion that existed in the minds of many people as to the origin and nature of the gaseous bubbles given off by the action of acids on the ore, especially in the Potter and Delprat processes. At first, it was supposed that as the bubbles buoyed up the sulphides they must be generated in place. An investigation of their nature, however, showed that they consisted chiefly of carbonic acid, and that they could not have been generated by the action of acid on sulphides. It is so well known nowadays that they are formed by the action of acid on the gangue or on oxidised sulphide that the former mystification on the subject is a matter of wonderment.

Tungsten.—According to O. J. Steinhart in *The Mineral Industry*, Vol. 17, the output throughout the world of tungsten concentrate, averaging 60% tungstic acid, during 1908, was less than 6,000 tons. The price per unit (22·4 lb.) of tungstic acid has varied between wide limits during the last ten years : from 1900 to 1902 the average was 10 to 12s.; in 1904 the price went to 45s., and in 1907 to 51s. During 1908 it first sank from 31s. to 19s. and then recovered to 27s., at which price it stands nominally at present. Producers anticipate higher prices before long.

PERSONAL

AUDLEY H. ACKERMANN, consulting engineer to the Consolidated Goldfields of South Africa, is in England on a brief holiday.

W. J. BARNETT returned to London in August from Siberia, and has been appointed consulting engineer to the Poderosa mines, in Chile.

FRANCIS L. BOSQUI has been engaged by Wernher, Beit & Co. and leaves London for Johannesburg on October 20.

F. W. BRADLEY has completed his usual tour of inspection to the Alaska Treadwell and Bunker Hill & Sullivan mines, in Alaska and Idaho.

WALTER BROADBRIDGE was in London in August and has returned to the West Coast of Africa.

R. GILMAN BROWN has returned from West Africa, and in excellent health.

CHARLES BUTTERS was at Carlsbad in August.

W. A. CARLYLE, recently appointed professor of metallurgy in the Royal School of Mines, was in Norway recently.

J. PARKE CHANNING was in England in July and enjoyed a motoring tour in Cornwall.

J. H. CURLE returned from Cashmir in July, and in August he went on a short tour to Norway.

JAMES DOUGLAS was in London for several months and sailed for New York on Sept. 4.

ROWLAND FEILDING has been examining mines near the Irtish river in Siberia.

W. E. GORDON FIREBRACE is in Peru.

R. J. FRECHEVILLE is expected in London on his return from Pachuca, Mexico.

W. FRANK GRACE has been examining the Waihi Grand Junction mine, in New Zealand.

F. H. HATCH is advisory geologist to the Government of Natal.

HARVEY & WILBRAHAM are consulting engineers to the Peña Copper Mines, Ltd.

CHARLES S. HERZIG returned recently from Nicaragua, where he is directing work on the Leonesa mine.

ALEXANDER HILL was in Spain during August.

H. W. HILL, formerly in West Australia, has gone to Stanleyville, in the Congo Free State.

HOOPER & SPEAK have been appointed consulting engineers to the Famatina Development Corporation, Ltd.

JAMES F. KEMP was one of the geologists engaged to testify in the big law suit pending at Wardner, Idaho.

C. B. KINGSTON, of the firm of Pearse, Kingston & Bourne, is in London from Johannesburg. He goes to Montreal on a short holiday visit.

ERNEST LEVY has gone to Rossland, as representative of Alexander Hill & Stewart.

W. J. LORING suffered from an attack of malaria contracted in West Africa, but he has completely recovered.

MALCOLM MACLAREN is making a geological examination of the Kalgoorlie district.

ALFRED F. MAIN is now manager of the El Oro mine, in successsion to R. M. RAYMOND, who is managing director and resides in the city of Mexico.

H. F. MARRIOTT will return from Canada about September 10.

EDWARD T. MCCARTHY went to Siberia in June; he has not yet returned.

T. A. RICKARD has resigned as member of the Council of the Institution of Mining and Metallurgy.

W. H. SHOCKLEY is at Sabolinaya, in Siberia, where he is examining the Kluchi mines for Hooper & Speak.

H. L. SMYTH and J. R. FINLAY have formed a partnership, with offices in New York.

ARTHUR L. WALKER and H. A. PROSSER have joined forces as consulting metallurgists in New York.

D'ARCY WEATHERBE is returning to Rio Tinto, having recovered from an attack of pneumonia.

HARRY H. WEBB has recovered from his recent illness and is now at New York.

GEORGE E. WEBBER has resigned as general manager for the Rand Mines, Ltd., and is now in California.

W. H. WEED and FRANK PROBERT have arranged a partnership, to begin in October, with offices at Los Angeles and New York.

LEWIS T. WRIGHT was in England recently, returning to San Francisco in August.

Mines in the United Kingdom.

THE first part of the Government Report on the mineral production of the United Kingdom for 1908 was published at the end of July, 1909. It contains statistics of the persons employed, the output, and accidents at mines and quarries, arranged under the twelve inspection districts. Parts II., III. and IV. will appear later. Part II. will deal with labour reports; Part III., with details of the output; and Part IV., with statistics of the colonies and abroad. As abstracts of Part I. have appeared in the daily and weekly Press, and as the bulk of the report deals with the coal and iron mining industries, in which our readers are not specially interested, it is not desirable to enter into details here. In any case, the information in Part I. relating to the tin, lead, and zinc production is not complete, and we shall deal with these metals when the fuller statistics are published in Part III.

It is, however, an opportune time to point out that these statistics of production can hardly be useful without a fuller explanation than is possible to give under the Acts of Parliament. For instance, the official figures for the output consist of returns made under three heads, namely, the output of mines worked under the Coal Mines Regulation Act, the Metalliferous Mines Regulation Act, and the Quarries Act. Under the first heading come all mines of coal, stratified ironstone, shale, and fireclay; the second includes all other mines; while the third deals with quarries more than 20 ft. deep. Now it just happens that in Lincolnshire and the Midland Counties there are many surface ironstone deposits where the workings are not 20 ft. deep. There are no statutory powers for the collection of figures relating to their output, and they are apparently not included in the returns under the Mines and Quarries Acts. Large amounts of salt from brine similarly escape official recognition, as also does the stream tin and the tin caught on the foreshore. The inspectors collect a certain amount of information relating to these outputs and include it in a sort of addendum to the official returns. The details about the output of ironstone are worth giving, seeing that this addendum brings the figures to something like the truth. In general figures, nearly 8,000,000 tons were produced from stratified deposits in North Yorkshire, Durham, Staffordshire, and Scotland, and nearly 1,500,000 tons in the Cumberland and North Lancashire hematite mines. Under the Quarries Act, the returns from Lincolnshire and the Midlands show a production of nearly 5,000,000 tons. Then comes the point to which we have drawn attention. No less than 789,000 tons were estimated to have been won from quarries less than 20 ft. deep, and these figures do not appear in the official returns under the Acts.

The information relating to iron ore production in Great Britain are of interest to those who have imagined that the deposits are worked out. Because English ironmasters import high-class ores from Spain and other countries, it is supposed, by those not intimately acquainted with the subject, that the British deposits yield much less than they actually do. As a matter of fact, the iron ores imported amount to less than one-half of the home production, but because the imported ores are oxides and the larger proportion of the home ores carbonates, the ratio in iron contents between imported and home ores is greater.

An instance of the ignorance extant relating to the iron ores of Great Britain is seen in Lucius W. Mayer's recent book on 'Mining Methods in Europe.' He is unaware of the existence of the carbonates in the oolite in Lincolnshire and the Midlands, and of the ironstone production of Scotland. Another queer statement he makes is that the coal industry of Scotland seems to be unprofitable. A traveller of a more inquiring turn of mind would have mentioned the interesting fact that some of the Scotch bituminous coal is hard enough to stand the burden of a blast furnace, and is therefore used raw. Consequently, the gases are particularly rich in by-products, and the methods for recovering them present a study of exceptional interest.

Wild Stories have been afloat in the Transvaal about a gigantic diamond that has been spirited away from the Premier mine and held for ransom in the mountain fastnesses. The fact that the Cullinan diamond as discovered was obviously only part of the original provides food for romantic imaginations. Theories as to where the remainder went are plentiful; to some it seemed probable that the diamond was broken by a blow from the excavating apparatus, but the argument against this idea is that the splinters would have been caught in the washing process and identified.

COMPANY REPORTS

Botallack Mines. — This company was formed two years ago by the Allen-Meyerstein group for the purpose of acquiring and re-opening the Botallack tin mine, near St. Just, Cornwall. W. R. Thomas succeeded William Thomas as manager a year ago, and Bainbridge, Seymour & Co. were appointed consulting engineers last autumn. The report now presented covers the financial year ended March 31, but the engineer's and the consulting engineers' reports on the working of the mine bring the information up to July. Over £60,000 has been spent in development, machinery, buildings, and administration, and according to the present report, there is a probability that £50,000 more will be required. The underground work has proved to be difficult, as might be expected, seeing that the previous owners never kept any records. The old shafts and levels were found to be in bad order, and in several places long-forgotten workings were encountered. On more than one occasion the clearing and development brought in unexpected rushes of water; therefore the pumping question has been an anxious one. Most of the ore raised so far has been obtained in clearing the old workings, and it has naturally been of low grade. At several points richer ore has been found in the stopes, running up to 50 lb. black tin per ton, and the reason for it having been left by the old owners is not quite clear. Such development as has been done at the lower levels has proved the existence of good ore, so that W. R. Thomas and Bainbridge, Seymour & Co. agree in recommending the continuation of the sinking of the new Allen shaft in order to make it possible to develop the lower levels economically. The performance of the dressing plant is, of course, no fair criterion of the possibilities of the mine. It began work in August of last year and has treated the old dump as well as the ore raised in clearing the levels. During the year to July 31, the tonnage treated was 28,282 tons and the concentrate produced was 125 tons, which realised £9,491. The plant consists of a 20-stamp mill and dressing-tables. Another 20 stamps are on the spot waiting for erection when there is a supply of ore for them. The income from the sales was, under the circumstances, naturally less than the expenditure. The company has come to the end of its financial resources and is creating £50,000 of 5% debentures. The method of issue is complicated. It is stipulated that the debenture-holders may exchange into ordinary shares at par at any time up to June 30, 1911, and that the debentures will be redeemable at 5% premium by means of ten annual drawings, commencing May 31, 1912. But the debentures are not being issued in this form. Instead, £10,000 of income bonds are being offered. The holder of each £10 income bond will be entitled to a bonus of £5 payable out of profits by yearly instalments of £1. Any amount not paid in any year will remain a first charge on profits until paid. The holders of the bonds may, from the date of allotment until December 31, 1910, exchange into the debentures. Those who do not so convert their bonds will have their money repaid by yearly instalments of £2 per bond after the payment of the bonus. The property of the company is already mortgaged to the Cornish Consolidated for money advanced; the latter company is likely to take up some of the debentures in satisfaction for the debt.

The Arizona Copper Company.—This company owns the Longfellow, Metcalf, and Coronado mines at Clifton, Arizona, and the railway from Clifton to Lordsburg and Hachita. The control is in Edinburgh. Norman Carmichael is general manager and Robert Addie, of London, is consulting engineer. According to the interim report for the half-year ended March 31, the net profit from the mining operations was £105,754 and from the railway £62,399, a total of £168,153. Out of this, £4,282 is being paid as interest on terminable debentures, £10,854 as income tax, and £12,265 as dividend on preference shares and stock, leaving a surplus of £140,750. An interim dividend at the rate of 25% for the six months on the ordinary shares absorbs £94,993. The production for the half-year was 8,241 short tons of bessemer copper, which realised £437,569. The yield was 2·22% of the ore treated. A plant for briquetting the fine concentrate and flue-dust has been erected.

Central Zinc Company. — This company was formed in 1906 for the purpose of erecting a zinc smelter at Seaton Carew, West Hartlepool, to treat zinc concentrate produced by the Minerals Separation Co.'s flotation process at the Central mine of the Sulphide Corporation at Broken Hill. The company is under the control of the Sulphide Corporation. H. M. Ridge was until recently manager and engineer, and it was under his direction that the works were erected. He has resigned, as has also E. Herter, the technical superintendent. J. C. Moulden, formerly assistant manager under C. F. Courtney at the Cockle Creek works of the Sulphide Corporation, has succeeded them and combined the two offices. Progress at the works at Seaton Carew has been slow. The report of the company for the year ended March 31 last does not show an encouraging state of affairs. The works have been admirably designed and are up-to-date, with retort-moulding machines, Merton furnaces, sulphuric acid plant, etc. In *Engineering* for January 29 of this year a detailed description, drawings, and illustrations of the buildings were given, though the parts interesting to metallurgists were entirely omitted, thus making the article of little value to the student of zinc distillation. We believe that no other zinc ores are used to mix with the company's own roasted sulphides. These ores are high in lead, as are most zinc concentrates at Broken Hill. Other Broken Hill companies, such as the Zinc Corporation, sell their zinc concentrate to German smelters, who mix this product with carbonates and other purer ores so as to reduce the lead content of the charge. The report for the year in question states that 2,182 tons of concentrate were treated, producing 587 tons of spelter. It was never possible to start more than one furnace, owing partly to the smelting difficulties, and partly to the absence of skilled labour; consequently, a loss was made of £15,410. The intention of the company is eventually to treat 40,000 tons of ore per annum. It is reported that the technical difficulties are being overcome satisfactorily and that the supply of skilled labour is improving. In a short time a second distilling furnace will be in operation.

Associated Gold Mines of Western Australia.—This company owns the Australia leases at Kalgoorlie. The control is in the hands of Messrs. Brookman, Waddington, and Landau; George M. Roberts is the manager. The sulphide ores are treated in the usual way at this centre of mining, by roasting, cyaniding, and filter-pressing. The fifteenth annual report covers the year ended March 31. A yield of 61,751 oz. fine gold was obtained from 125,794 tons of ore. The extraction was 91·6% and the residues averaged 0·9 dwt. By means of vigorous development and the provision of additional plant the output has been raised to the above figures, which compare with 219,799 oz. from 430,414 tons in the previous year and 170,864 oz. from 330,278 tons during the year before that. The extraction plant has been still further enlarged, and in March the monthly tonnage was increased from 10,000 tons to 12,000 tons. The ore reserves on March 31 were estimated at 483,517 tons, averaging just under 10 dwt. The working costs are given in full detail. The total cost of mining, administration, taxes, etc., at the mine and in London were £1 0s. 11d. per ton. In addition to this, £31,029 was spent in mine development; the cost of this is not charged up year by year to revenue, but to a separate account from which sums are written off every year. The income from the sale of gold during the year was £262,397, and dividends on investments amounted to £6,819, bringing the total receipts to £269,216. The net profit carried to the balance sheet was £125,792. Out of this, £40,274 was written off the mine development account and £2,629 off the diamond-drilling account, while £21,330 was provided for depreciation of plant. Dividends amounting to £61,920 were paid, which is at the rate of 12½% on the paid-up capital.

Wheal Kitty and Penhalls United. — The report covers the six months ended June 30. The mine is situated in the St. Agnes district of Cornwall. It was re-opened a few years ago at the instance of J. H. Collins, who is chairman and director of operations. The company is one of the few that have managed to make a working profit recently, and dividends have been paid, though naturally Mr. Collins would have preferred the shareholders to forego their returns and thus supply the mine with further funds. The nominal capital is £35,000, of which £25,762 has been issued. The purchase price was £13,000 in shares, and the capital expenditure to date is £12,192. Early in 1909 new capital representing £3,317 was raised for the purpose of improving the dressing-floors and providing additional pumps. During the six months ended June 30, the stamps treated 6,028 tons and yielded 120 tons of tin concentrate, which sold for £9,990. The average price obtained was £83 and the average yield was 44½ lb. per ton. After all expenses have been paid, including £499 for royalties, the net profit was £2,600. This profit, added to the amount carried forward from the last account, leaves a balance of £5,027. Out of this a dividend at the rate of 7½ % per annum is being paid, absorbing £912. Out of the balance, £1,920 is written off development account and £431 is allowed for depreciation of plant. Owing to the adjoining mine, the West Kitty, suspending work in one section, additional water now comes into Wheal Kitty. To cope with this an electric pump has been erected and is already in operation.

Carn Brea and Tincroft Mines.—This Cornish tin mining company presents its report for the half-year, January to June, 1909. During recent years the results have hovered between profit and loss. Since the sale of these mines to the present limited company in 1900, the only dividend paid was one of 10% on the priority shares, in 1907, during the period of high prices for the metal. There are 38,607 priority shares of £1 each, and 96,953 ordinary shares of the same denomination, the former being entitled to all profits up to £1 per share and then ranking equally with the latter. For some years the advisability of raising a large sum of new capital for the re-organization of the mine and machinery on modern lines has been debated, but the step has not yet been taken. Instead, great efforts have been made by the manager, John Penhall, to improve the efficiency of such plant as is at his disposal. A marked improvement has been made in the amount of ore won and the extraction of concentrate during the last two years; for instance, during the first half of this year 36,825 tons were treated and 567 tons of concentrate produced, as compared with 28,820 tons and 339 tons, respectively, during the first half of 1907. It will be seen that the extraction has been raised from 26·42 to 34·55 lb. The income from the concentrate sold was £39,428, and the total income, including that from the sale of the by-products (arsenic, copper, and wolfram ores) was £42,846. The total expenses were £39,745 and the lord's dues £1,550, leaving a profit of £1,550.

Tronoh Mines.—This company owns tin gravels in the Kinta district of Perak. It was formed at the end of 1901 with a capital of £160,000, and up to the end of 1907 total dividends amounting to £242,423 had been distributed. The control was in the hands of the original vendors, E. G. Edgar and Foo Choo Choon. After seven years' spell of success things began to go wrong. The London board of directors, including among them C. V. Thomas and Gilbert B. Pearce of Cornwall, have taken more direct charge, and Harry D. Griffiths is now engineer and manager. About two years ago it became evident that further underground working was impracticable, and G. E. Stephenson, the engineer in charge at that time, recommended an alteration to the open-cut system. Substantial sums of money were spent on new plant for the purpose of carrying out the new policy, but it was soon found that the mine was in a worse condition than was supposed, and that the money had been spent to no advantage. Hence the changes in control and management. Mr. Griffiths has been occupied for many months in a study of the local conditions. Landslides and rains make operations difficult, and the fear is that the mine will have to be abandoned. The directors have consulted R. J. Frecheville, and his opinion is awaited with interest. In the meantime work is going on, but the output is less than it was two years ago. The report for 1908 shows that 1,712 tons of tin concentrate were sold, realising £123,683, while the mining costs were £101,073. Other expenses and allowances for depreciation reduce the net profit of the year to £11,489, which is carried forward.

The Mount Morgan Gold Mining Company.—This company presents its report for the year ended May 31. The mine, near Rockhampton, Queensland, is one of the great ones of the world. Originally a gold mine pure and simple, it was found in 1903 to contain sufficient copper to warrant the smelting of the auriferous pyrite. It is also noted for the success that has attended the chlorination process used in the treatment of pyritic ore. The company is controlled locally and the manager is G. A. Richard. During the year in question 108,191 tons of oxidised ore yielded 17,236 fine ounces of gold. This class of ore is now nearly exhausted. The chlorination process produced 48,284 oz. of gold from 106,952 tons of ore, and 453 tons of copper in the form of precipitate was obtained as a by-product. At the smelter 183,586 tons of ore yielded 5,346 tons of copper and 72,822 oz. gold. The ore reserves are increasing and stood on May 31 at 1,368,000 tons, containing $3\frac{1}{2}$ per cent. copper and 8 dwt. gold, in addition to which there are large quantities of lower grade stuff. Hitherto the company has sold its unrefined blister copper, but before long this will be treated at the new electrolytic works at Port Kembla, New South Wales. Last autumn the accidents due to serious creeps rendered it necessary to modify the method of mining and interrupted the output. Arrangements had been made for an increase in the amount smelted, but the stoppage of ore supplies caused by the accidents prevented full advantage being taken of the new plant; consequently, the yield of metals is not much different from that of the previous year. The average price obtained for the copper sold was £61 5s., as compared with £74 10s. a year ago. The report does not state how much copper remained unsold. The profit for the year was £228,215, out of which £200,000 has been distributed in dividends.

Broken Hill Proprietary Co.—The report for the six months ended May 31, presented by the leading company of the Barrier range, is not of the usual interest, as the labour strike has seriously interfered with operations. The smelter at Port Pirie was only running for one month, and the ores treated, some purchased and some the company's own production, amounted to only 17,936 tons, as compared with 132,979 during the previous six months. The production from these ores was 438,109 oz. silver and 7,609 tons of lead. Naturally the result of operations is a financial loss, which amounts to £59,000. It has been necessary to transfer £129,837 from outside reserve into the company's business. Owing to the high rate of wages awarded by the Arbitration Court, the costs at the mine are incompatible with a profit at the present low prices of metals, and the mine is closed down pending an improvement in the market.

Broken Hill South Blocks.—This report covers operations during the year ended March 31, 1909. The mine was originally worked by a local company, and was, through the agency of Lake View Consols, Limited, acquired by the present English company in 1905. The managers are Bewick, Moreing & Co., and the mine superintendent is J. A. Diggles. The mine is the most southerly of those on the Barrier range. During the year under review, 103,299 tons of ore were treated, producing 20,525 tons of lead concentrate, averaging 64·67% lead and 8·78 oz. silver. Recently the concentrating plant has been modified in such a way that a zinc middling is obtained from the Wilfleys. About 20 tons per day is thus obtained assaying from 18 to 21% zinc, 2 to 3 oz. silver, and 5% lead. This is being stacked, as also is the remainder of the zinc tailing, for treatment at some future time. The lead concentrate is sold under contract to the Broken Hill Proprietary Co. Owing to the labour troubles, and the consequent temporary closing down of the Proprietary's smelting works at Port Pirie, the concentrate has not been delivered regularly, and the income of the company has been curtailed. Advances have been obtained on the security of the concentrate to the extent of £23,000, in order to provide working funds. The ore reserves on March 31 were 421,090 tons, assaying $16\frac{1}{2}$% lead, 3 oz. silver, and 10·6% zinc. The efficiency of the plant has been substantially improved, and the extraction of lead has been increased during the year from 70·8 to 80·4% and the silver from 61·6 to 71·2%. The improvement is due to the additional Wilfleys in use and to the excellent

Plan of the Broken Hill mines, New South Wales.

classification effected by the B.M. revolving screen. The financial results show a small margin of £7,131, which is only a profit on paper, as the value of the the concentrate produced is only an estimate, and the money has not been received.

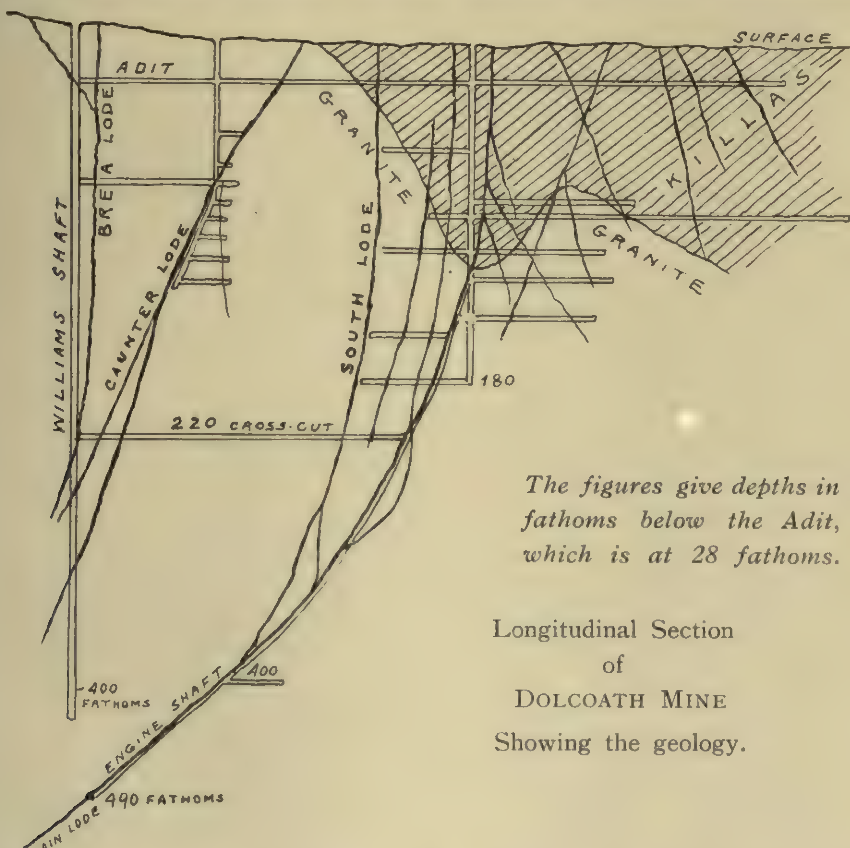
Broken Hill Proprietary Block 14. — This company presents its report for the six months ended March 31, 1909. The mine is in the northern part of the Barrier range between the Broken Hill Proprietary and the British Broken Hill. The company is controlled in Melbourne. F. Voss Smith is manager, having succeeded James Hocking in May. Eighteen months ago the drop in the prices of metals made it necessary to close-down the sulphide mill. As there is no immediate hope of recovery in prices, the management is investigating the possibility of improving the dressing plant. While sulphide concentrates are not being produced, the carbonate ore left in the upper levels is being mined. During the half-year under review 10,253 tons of carbonate were shipped, containing 3,309 tons of lead and 102,700 oz. silver. Exploration work has disclosed further supplies of carbonate, and the amount ready for extraction on March 31 was about 15,000 tons. The reserves of sulphide ore still stand at 220,000 tons, averaging 12 % lead, 8½ oz. silver, and 9 % zinc. Further exploration has not yielded anything of value. The company owns large stocks of zinc tailing which are under contract of sale to the Zinc Corporation. As regards the financial position, the sales of carbonate ore during the six months yielded an income of £18,008 and the expenses were £22,217. A balance of £79,327 is available for better days.

Broken Hill Proprietary Block 10.—This company's mine is situated between the properties of the Broken Hill Proprietary and the Central mine of the Sulphide Corporation. The control is in Melbourne and the engineer is V. F. Stanley Low. During the period under review, the six months ended March 31, operations have been restricted by the strike; in fact, from the middle of January work was at a standstill. The ore treated consists entirely of sulphides. Of these 33,563 tons went through the concentrator, producing 5,803 tons of concentrate assaying 61·4 % lead, 9 % zinc, and 32·8 oz. silver. The recovery was 72·6 % of the lead and 42 % of the silver. In addition, 27,759 tons of zinciferous tailing was produced. The company has contracts for the disposal of this tailing to the Zinc Corporation and to the De Bavay's Treatment Co. During the six months under review the company received £35,700 from the Zinc Corporation, which clears off arrears of payment, and £54,321 is still to be received. The De Bavay Co. has bought 300,000 tons of tailing, and payment commenced in July. No figures relating to ore reserves are given, but details of development show that ore is being opened up. The sale of lead concentrate yielded an income of £39,910 and the working costs were £36,125. The receipt of the large amount from the Zinc Corporation made it possible to declare a dividend of £10,000, which is at the rate of 1% on the nominal capital, and also to supply the company with additional cash, which was welcome owing to the strike.

Robinson Deep Gold Mining Co.—This company owns property adjoining the Robinson, Worcester, and Ferreira mines, and is controlled by the Consolidated Goldfields. Operations commenced in 1898 with 40 stamps; at the present time there are 300 stamps and five tube-mills at work. The report for the year ended March 31 shows that 259,112 fine ounces were obtained from 649,001 tons passed through the mill. The stamp-duty averaged 6·36 tons per day. The value of the gold won was £1,092,224, and the extraction was 33s. 8d. per ton. The total working expenses were £519,914, or 16s. per ton. Out of the profit £416,500 has been distributed as dividend at the rate of 42½% on the capital. During the year it has not been possible to keep up developments to the usual standard owing to the interference caused by the sinking of No. 2 incline; this incline has only three compartments, so that sinking and hauling have interfered with each other. The development of this part of the mine has consequently been retarded and the general ore reserves have not been fully maintained. The incline is now being widened to a five-compartment shaft with a view to more rapidly developing the south-west section of the mine. The future policy will be to lower the grade and increase the tonnage milled to 60,000 tons per month. The ore reserves are estimated at 1,200,000 tons, averaging 7½ dwt. in the Main Reef leader and the South Reef. No part of the Main Reef is included, owing to the impossibility of determining whether it is payable or not.

Dolcoath Mine.—This famous mine is controlled partly in Cornwall and partly in London. The Cornish directors include the names of Harvey, Holman, and Pearce, while Oliver Wethered and others represent the capital subscribed in London in 1895, when the company badly wanted it and could not raise it locally. R. Arthur Thomas is manager. The report for the first six months of the year shows a net profit of £14,827, out of which £1,889 is being provided for payment of income tax and £2,478 for depreciation, leaving a divisible profit of £10,459. Out of this a dividend of 6d. per £1 share, absorbing £8,500, is being paid. The ore raised amounted to 45,880 tons, which is about 4,000 tons less than the average for recent half-years, but, to make up, the recovery has increased to 48·85 lb. per ton as compared with from 37 to 40 lb. during the last six years or so. The increase in the yield is due to the important discoveries at the bottom of the mine. The production of concentrate was 1,000½ tons, as compared with 902 tons during the immediately preceding six months. Not for 15 half-years has the yield reached four figures. Of the production, 931 tons were sold at an average of £81 6s. per ton, and 69½ tons of slime brought £59 18s. per ton, a total of £79,864. Copper ore produced by the Elmore vacuum-plant sold for £543 and interest, and other items brought the total income to £81,800. The working costs were £61,621 and the lord's royalties £5,351. As already mentioned, the developments at depth are important. It is owing to the available ore being of higher grade that it has been possible to take labour away from mining and transfer it to development, without decreasing the product or increasing the cost. The new main shaft is now 2,541 ft. deep and will make connection with the 2,640 ft. level in a few weeks. A study of the results since the present limited company was formed is interesting. During the second half of 1895, the ore crushed was 28,717 tons and the yield of concentrate 1,015 tons, an average of 79 lb. per ton. Those were the ruinous days when the price of black tin was only £39 per ton. For six years the yield remained about the same, while the amount of ore treated was nearly doubled, the average content falling gradually to only a half of what it was in 1895. At the same time the price gradually improved. These facts give point to the remark once made by Capt. Thomas to a cantankerous shareholder, who inquired what was the lowest price of tin compatible with a profit: "Whatever the price of tin, Dolcoath has always made a profit."

Anglo-French Chemical Works.—This English company has been formed for the purpose of acquiring the works of the Société Anonyme Le Blanc Ardennais, at Vireux, in the Ardennes, France, where 'lithopone' is manufactured. Lithopone is a white pigment introduced some years ago in Germany as a substitute for white lead and zinc white. It is formed by mixing solutions of barium sulphide and zinc sulphate, and it consists of the insoluble precipitates of the reaction, namely, zinc sulphide and barium sulphate.



The figures give depths in fathoms below the Adit, which is at 28 fathoms.

Longitudinal Section of DOLCOATH MINE Showing the geology.

The barium sulphide is readily formed by heating barytes with coal at a bright red heat, and the zinc sulphate is obtained usually direct from ore. Originally made in Germany, its manufacture has spread to France and to the United States. The recent prohibition of the use of white lead in France has naturally given a fillip to rival products, but probably the cheapness of manufacture is the chief reason why lithopone is being taken up. The raw materials used are much less expensive than those used in making white lead or zinc white and the process of manufacture is also cheaper. The present prospectus gives the selling price of lithopone at from £11 to £14 per ton, compared with from £20 to £28 per ton for white lead and £24 to £32 for zinc white. These relative prices are no indication of the comparative value of the pigments to the painter. The covering power has to be considered, and also the amount of adulteration with barytes and whiting.

The Wolfram Mining & Smelting Company.—Capital: £100,000, of which £80,000 is now issued. The vendors are the Buitenlandsche Bankvereeniging of Amsterdam, who receive £30,000 in shares and £5,300 in cash as purchase price. They also guarantee the issue of 40,000 shares for cash and receive 10,000 shares as underwriting commission. The sum of £34,700 will be available for working capital and for meeting preliminary expenses. The mines acquired by the company are named the Panasqueira and Cabeco da Piao, situated near the town of Silvares in Portugal. The first named has been worked for many years and the latter was opened as recently as 1906. J. D. Kendall has examined the mines, and his report shows that the wolframite occurs with some iron and arsenical pyrites in narrow veins of milky quartz traversing schistose rocks. The veins vary in thickness from an inch to two feet and average about eight inches. The content of wolframite is 1·14%, and by means of jigs and Ferraris tables a concentrate is produced, averaging 70% of tungstic acid. During the five years ended December 31, 1908, over 800 tons of concentrate have been produced. Mr. Kendall estimates the ore reserves at 100,000 tons, which should give 1,000 tons of concentrate. The present issue of capital is required for additional development work and for the provision of better concentrating plant.

PRÉCIS OF TECHNOLOGY

Electro-Analysis.—Edgar F. Smith, professor of chemistry in the University of Pennsylvania, and author of the book on electro-analysis, has described the advantages in the matter of time obtained by the use of a rapidly-revolving platinum disc as an electrode. Hitherto the mechanical methods of carrying out this idea have been crude. *The Electro-Chemical and Metallurgical Industry* for July describes an improvement, introduced by C. J. Reed, of Philadelphia, which renders unnecessary the separate motor and belt. The apparatus consists of a platform revolving on a vertical shaft, the platform being itself the armature of a motor. The beaker containing the solution to be electrolysed is centred automatically on a floating disc, which rests upon and covers the platform. Electrodes of any form and material may be used. Contact with a mercury cathode may be made by a wire passing through the glass beaker or by a platinum wire sealed into a glass tube and inserted from above. The speed is adjustable by means of a screw. The motor consumes from 3 to 5 watts and may be operated by the same current as is used in the electrolysis.

Formation and Enrichment of Ore-Bearing Veins.—George J. Bancroft, a mining engineer of wide experience, has written a paper on this subject to be read at the Spokane meeting of the American Institute of Mining Engineers in September. It is in the nature of a supplement to the paper contributed by him in April, 1907. It deals particularly with a suggestion that chlorine, free or combined, may be an agent for extracting the metals from magmas and depositing them in veins. He quotes evidence of the presence of chlorine and other halogens and their compounds in volcanic emanations. The present theory was suggested by a study of Malm's dry chlorine process, which depends primarily on the facts that in the dry state chlorine has a greater affinity for the metals than sulphur or oxygen, and that the chlorides of all the metals are soluble together in hot water. Thus cupric chloride, lead chloride, zinc chloride, gold chloride and iron chloride are soluble in hot water direct and silver chloride is soluble in hot cupric chloride. The author takes the case of a magma at a temperature of 1000°C. containing chlorine, water-gas, sulphur, silver, copper, lead, iron, zinc, and gold, the chlorine existing in a greater quantity than is required to form chlorides with all the metals. As this magma approached the surface, the chloride would attack all the metals except gold, and the chlorides would be gaseous at the temperature of 1000°C. Gold chloride decomposes under atmospheric pressure at about 120°C. The issuing gases would be under some amount of pressure above that of the atmosphere and as pressure raises the temperature of decomposition, it is difficult to say at what temperature of the magma the gold would accompany the other metals. The farther from the magma the gases travelled the cooler they would become, and eventually they would liquify. We should then have the chlorides of the metals in a hot aqueous solution together with sulphur and sulphur chloride. Precipitation would take place according to the constituents of the rocks encountered. The author proceeds to show the precipitating action of such constituents as lime and silicates, and also explains how sulphuretted hydrogen precipitates the metals as sulphides.

Decomposition of Ferric Oxide.—In a short paper contributed to the *Bulletin* of the American Institute of Mining Engineers for July, H. O. Hofman and W. Mostowitsch, of Boston, give the results of their investigations into the decomposition of ferric oxide when heated in a current of dry air. They found that ferric oxide, $Fe_2 O_3$, heated to 1360°C. in a current of dry air at atmospheric pressure for 30 minutes remains chemically unchanged and that at 1375°C. the loss in oxygen amounts to 4·4 %. The substance which at 1360°C. has sintered but is not attracted by the magnet, becomes magnetic at 1375°C. and contains some FeO.

Valuation of Mines.—Three papers bearing on this subject were read before the Institution of Mining and Metallurgy on April 22, 1909, by W. Fischer Wilkinson, W. R. Feldtmann, and W. H. Goodchild. In all of these the questions of total quantity of ore available, percentage extraction, and tonnage yield were assumed; consideration was confined to the means of obtaining the largest ultimate profit from treating the ores and computing the present value of proved ground. It was pointed out in the discussion, and accepted by Mr. Wilkinson and Mr. Goodchild, that such calculations could only apply to 'banket' and coal mines, although they might be equally applicable to estimating the value of ore reserves in other kinds of mining; for instance, they are particularly applicable to gravel mines and dredging ground. Mr. Feldtmann, however, stated that his paper was not confined to 'banket' deposits, but was supposed to embrace quartz veins as well. Some of the interesting points were:

COSTS PER TON MILLED.—It was shown that of 53 milling companies on the Rand, the costs decreased directly as the tonnage increased from an average of 23s. 4d. per ton on the mines treating less than 10,000 tons to 14s. 8d. on those treating 40,000 tons and upward, this being due, chiefly, to the distribution of certain irreducible standing charges over the largest possible tonnage. An increased scale of crushing generally means the inclusion of an increased area of ore deposit varying in value, or the bringing of another, and lower grade, deposit within the range of mining operations. This affects the economic question in three ways: (1) By reducing the cost per ton without lessening, to a corresponding extent, the production per ton. Such a policy shortens the life of the mine, but yields a larger profit per ton, and therefore yields a larger total working profit during its life as well as a higher rate of working profit per annum. (2) By reducing the cost per ton and simultaneously, and to a greater extent, lowering the grade through addition of ore yielding more per ton than the rate of costs on the original scale of working. This shows a decreased rate of profit per ton on the augmented tonnage and also shortens the life of the mine, but as the profit on the original tonnage and grade is increased, by the reduction in costs, and the added tonnage also yields a direct profit, the total working profit during the life of the mine is increased, as is also the annual working profit. (3) By reducing the costs per ton and simultaneously, and to a greater extent, lowering the grade, through additions of ore of less yield than the cost, but sufficient to more than cover the "unit charge" (that is, all expenses other than the fixed cost). This does not shorten the life, because the increase in tonnage is made up of material that could not be treated after the exhaustion of the higher grade ore. It increases the ore available and also increases both the total and the annual working profits.

WORKING RICH ORE FIRST.—It was generally conceded that, where possible to do so without loss of ore, or incurring additional expense in recovering that of lower grade if extraction be deferred, it is more economical to work high-grade ore during the early stages of a mine, when the equipment is relatively small, and reduce the grade as the equipment is increased. The only real objection raised to this was that it is in the interest of shareholders to maintain a uniform output. Mr. Wilkinson contended that there was no advantage in maintaining an even grade, and that an attempt to average returns implied that ore above the average was kept back longer than necessary, the effect being to depreciate the value of the property.

LIFE OF THE MINE.—The object in mining should be to make the maximum net profit during the life of the mine and this can only be done by making this 'life' such that its present capitalised value is the greatest possible. As long as gold is left in the ground there is a loss of interest and, after a certain period, this loss of interest will exceed the cost of new shafts and equipment. It follows that, if the profit per ton is high, the time in which the mine should be worked out, to produce the greatest profit, is less than if it is low; but it is seldom that a life of less than ten years can be taken as ideal. R. N. Kotze has defined this ideal life as extending to a point "at which the ratio of increase of present value of profits and increase of capital is unity." Based upon these data, the scale of operations most suitable for an individual banket property may be estimated, the plant being designed and increased with the purpose of conforming to the conditions. Mr. Feldtmann has expressed the matter as follows: "It is naturally premised that the additional ore necessary for increased crushing is available. Further, the enhancement of working profit during the life of the mine, due to an increased scale of operations, is subject to a deduction for the cost of additional plant required for augmented tonnage output. The estimated enhancement in working profit must, therefore, exceed the cost of the additional plant in order to justify increasing the tonnage crushed. Granted these premises, the maximum working profit will result in the maximum net profit being earned and the life of the mine does not further come into consideration of the effect on working profit of an increased scale of operations." In 'Economics of Mining,' published in 1905, the question of the 'life' of a mine was admirably summed up by H. C. Hoover. A certain part is visible in its ore reserves. With vigorous development and continuity in depth the ore reserves will gain on the treatment capacity and eventually reach a point where the visible life of the mine is equal to the period when "increment of profit overtakes amortization"; then an additional treatment unit should be installed. So long as the reserves continue to gain on the treatment plant, additional units should be erected, until the most vigorous development is no longer able to do more than keep pace with the output. Generally under these conditions the ore reserves will equal not more than a 3-years supply. That the ore reserves should be such that the increment of profit will overtake amortization before another unit of plant is erected is a matter of general policy, because every deposit of this class is sure to get poorer eventually and fail at some point in depth. The same principle of expansion would appear to be sound in dealing with the deposits of the Rand; only, these being more persistent in character and permitting generalisations that would be quite inadmissible in vein-mining, the units may be larger.

PRESENT VALUE OF MINING PROPERTIES.—The actuarial principles upon which the present value of mines may be discussed formed the basis of Mr. Goodchild's paper, and Mr. Wilkinson gives several instances of their application. In cases where a certain ultimate quantity of ore, of a certain approximate grade, is fairly assured, the elements of the calculations are: (1) Capital expenditure required for a given production. (2) The available tonnage and its value. (3) The cost of working. (4) The rate of interest required. These, of course, are all variable, but as long as they are decided upon and the actuarial formula to be used is agreed upon, the present value can be determined for any 'life' and the most remunerative life decided. The difficult point lies in determining these essential figures. The valuation of adjoining properties for purposes of amalgamation may also be calculated, but the questions of deferred value in deep-level properties, the so-called zone basis of valuation, and the amount of capital different properties will bring into the combination, all complicate the calculations. Thus bargaining plays a more important part in such amalgamations than would be generally admitted. It is difficult to summarise the conclusions reached in these matters; the discussion will repay careful perusal.

Mine Examinations.—Some useful hints on mine examinations were given by George E. Collins to the senior class at the Colorado State School of Mines and reported in the School *Bulletin* for May. In the first place Mr. Collins recommends the engineer to ascertain beforehand just what it is that his clients want to know in connection with the mine he is examining. Unless these definite instructions are obtained, the engineer is as likely as not to present a dissertation on the mine and on things in general that fails to give a plain answer to a specific question. Of course it is not always possible to provide an answer, and a limiting case of this sort is given by Mr. Collins. He had at one time prepared an elaborate and conscientious report on a prospect in the West of America into which an Eastern judge had been persuaded to put money. The report conveyed no idea to the judge, who asked Mr. Collins to answer in the form of a supplementary report the plain question yes or no: "Is this a great mine or is it a damned swindle?" The judge's ideas of mining were crude and Mr. Collins had difficulty in satisfying him when he replied that such a question could not be answered in the way he desired. Unfortunately those who employ the engineer are often hazy in their own minds as to what they really want to know. Therefore, an engineer should always ascertain beforehand the calibre of his employer and the specific information he requires. Arguing from the above considerations Mr. Collins has come to the conclusion that it is best to present two concurrent reports on every examination that he makes. One of the reports should be intended for the client himself, who is often unversed in the technicalities of mining and geology and requires a plain unvarnished tale as to whether or no he will get a run for his money; while the second or accompanying report should go into details, which will give his full professional opinion and be of use to other consulting engineers to whom it may be shown. Another question that often requires adjustment is: How much time should be spent on the property and what should be the corresponding fee? A client may want simply a general idea, or specific information on one point, or a full report. Until the exact requirements are stated a misunderstanding may arise. Mr. Collins is inclined to suggest that the fee charged should be based on the time given to the task. Another suggestion made by the author is that when time permits and the distance is not too great, the examination should be made in two or three distinct stages: the first visit to be a reconnaissance; the second, in sampling and detailed investigation; the third, a final survey for re-consideration and the maturing of opinions. It is remarkable what a clarifying effect an interval brings. The author devotes special attention to the question of the elimination of high figures in sampling. He quotes the usual practice of discarding unusually high assays and questions Rickard's recommendation to substitute two intermediate samples on either side of the rich one. He quotes the disinclination of the San Juan miner to accept such a system of sampling and his preference for an actual mill-run. Naturally, if the value of a property depends upon rich stringers or patches the rejection of rich assays is open to question. The author quotes specific cases where the rejection of high assays has made the average so low as to prove the property unpayable, whereas the actual mill-runs has justified the correctness of the average when the high values were retained. He is inclined to suspect that this practice of arbitrarily excluding all high samples has often been employed to cover up inaccuracies in other directions. For instance, many engineers make no sufficient allowance for the mixing of waste from the walls during mining.

Development of Heavy Gravitation Stamps.—A paper under this title written by W. A. Caldecott has been published by the Institution of Mining and Metallurgy, and it is to be read at a meeting in the autumn. It was not until 1899 that stamps heavier than the standard 900 pounds were used to any great extent in actual practice. In that year a weight of 1,250 lb. was adopted by the Robinson Gold Mining Co. In 1902 the Westralia Mount Morgans Co. erected 1,500 lb. stamps, and an adjoining mine, the Millionaire, went to 1,750 lb. In 1907 there were few stamps on the Rand weighing more than 1,250 lb., except on mines controlled by the Consolidated Goldfields, by which company the author was professionally engaged. In the year 1904 he made some experiments at the Knights Deep battery with a view to ascertaining what improvements could be made in stamp-duty; in particular, the comparative effects of double-discharge mortars and preliminary crushing through rolls set half-an-inch apart were investigated. The unexpected results obtained showed that no appreciable increase in the duty could be obtained by preliminary crushing by rolls, nor by having a double discharge; in fact, the latter presented a distinct disadvantage, as it entailed a considerable increase in the amount of water employed. Experiments were then tried with the object of increasing the force of the downward blow by means of springs. The increased noise and the inability of the springs to stand the strain caused this line of investigation to be dropped. The question of the increased weight of the stamps was then taken up, the conditions being varied from normal conditions to a high discharge and back-water feed, so as to obtain a very fine product. By increasing the weight from 1,196 to 1,531 lb. the amount crushed in 24 hours was increased from 5·88 to 6·74 tons, the height of discharge being 3 in., the drop 8 in., and the aperture 0·021 in. With the lower weight the percentage of + 60 (0·01 in.) grade in the screen-pulp was 22·63 and with the greater weight 20·86. With an 11 in. height of discharge and a 0·016 in. aperture the tonnage was raised from 4·26 to 6·02, when the weight was increased from 1,216 to 1,605 lb., the percentage of + 60 grade in the screen-pulp rising from 5·16 to 11·66. These results encouraged the author to recommend that the new stamps erected by the Goldfields Company at the Simmer East, Robinson Deep, and Luipards Vlei, should have a weight of 1,550 lb. All these stamps have given excellent results in practice. It may be mentioned here that the policy of increasing the weight of stamps has not been imitated in America; the only notable case being that of the Boston Consolidated, which has adopted 1,500 lb. in the new mill.

One of the objections to heavy stamps is that the foundation suffers from the shock. This view never impressed the author, seeing that no such difficulty had stood in the way of the development of the steam-stamp. Mr. Caldecott proceeds to give details of his experiments with various kinds of foundations. In 1906 a series of 23 comparative trials were completed on two 5-stamp batteries at the Simmer East mill, one with the mortar-box resting on a concrete block, and the other with the mortar-box resting on a cast-iron anvil-block placed upon a concrete foundation. Various screens were tried. The cast-iron anvil-block gave a stamp-duty averaging 6·84 tons, as compared with 6·78 tons for the concrete block; but the average screen-grading analysis of the latter showed only 25% of + 60 (0·01 in.) grade as against 26·76% for the cast-iron anvil-block. The mortar-box resting on concrete with only a thin layer of insertion has now been in use for three years with no visible sign of cracking or deterioration and, in consequence, the new mills at the Simmer Deep and the Jupiter have been erected on this plan.

The author then discusses the degree of fineness that can be reached economically in a stamp-mill, and points out that directly the action of the stamp begins to pass from an impact effect to abrasion, the efficiency suffers. The stamp is essentially an impact machine and hence readily pulverises hard ore; if, however, the hard ore is crushed too fine, the wear of the shoe and die becomes excessive. The author invites the invention of methods for testing the capacity of crushing materials to withstand abrasion and, conversely, for testing the amount of abrasion caused by various classes of ore. Another cause of inefficiency in stamp-mills when crushing fine was originally pointed out by Courtenay De Kalb and E. A. Hersam in the *Mining and Scientific Press* in 1908. This is that when too fine the particles simply re-arrange themselves under the blow of the shoe and so dissipate its force.

When working with heavy stamps it is desirable that the wear of the shoe and die shall be compensated by the addition of extra weights, so as to maintain the weight of the falling stamp at the normal figure. Probably the most convenient method is to bolt split cast-iron discs to the stem, these discs being about 4 in. high and weighing 50 to 60 lb. The author finally points out another incidental advantage of the heavier stamp, namely, the general decreased cost of plant and space occupied in relation to the output. For instance, 200 stamps of 1,750 lb. would cost less than 280 stamps of 1,250 lb.; the mill-building would be smaller; there would be 30% less shafting, belts, and other moving parts to maintain; and 30% less labour required for dressing plates, lubricating moving parts, changing screens, and other work incidental to milling operations.

In this paper Mr. Caldecott deals solely with gravitation stamps; he does not like the many propositions for increasing stamp-duty by resort to other mechanical means, although he allows an exception in favour of the Holman air-cushion stamp now being erected at the New Kleinfontein; of this device he speaks hopefully.

Electrical Winding.—In 1905 and 1906 W. C. Mountain, in the Transactions of the Institution of Mining Engineers, drew comparisons between steam and electrical winding; taking a number of steam hoisting-plants in actual operation he showed that the consumption of steam per horse-power-hour varied between 43 lb. at Sherwood No. 2 pit and 178 lb. at Cowpen. Notwithstanding these high figures he concluded that steam-hoisting was cheaper on account of the high first cost of electrical equipment and the interest chargeable on the extra capital account. He stated that with coal at 10s. per ton under the boilers there was a prospect of electric winding being economically adopted. Although many electrical engineers opposed these views and endeavoured to show that with coal at even much lower prices the advantage would be with electrical winding, there has been relatively little advance in this direction in this country and engineers have frequently stated that while electricity may be used with advantage for most power purposes on mines it should not be introduced for winding. A later paper by M. B. Mountain on 'Some Recent Electrical Winding and Haulage Plants,' published in Part III. of the current Transactions of the Institution of Mining Engineers is therefore timely. He says: "It would seem that the effect of the introduction of the Miners' Eight-Hour Act will be to make it essential for colliery owners and managers to consider the very best methods of speedily handling the coal and expediting its removal from the working face to the pit-head. The most important operations to be considered, therefore, are haulage, winding, and traction, and in the use of electricity in the performance of these operations upon a more extended basis lies, possibly, one of the solutions of the difficulties to which colliery managers are at present subject, and will probably be more so in the near future. The greatest attention has, of course, been required in the development of electrical machinery; yet there are instances in which many of the advantages and economies that might have been derived from electrical driving have been minimized by imperfect design in the mechanical portions of the gears or by the putting in of cheaply built mechanical apparatus. Careful consideration, therefore, should undoubtedly be given to the design of mechanical gears in order to get the best efficiency."

He devotes some pages to a consideration of haulage by electricity and the types of motors and machines used with the different systems of haulage, but these, being pretty generally understood, may be passed over briefly. Suffice it to say that plants of 200 to 300 h.p. are by no means uncommon and some up to 500 or even greater horse-power are now at work. As an instance, showing the saving of power by the use of electricity instead of compressed air, the Clifton colliery, at Nottingham, is quoted. The air-compressing engine was converted for driving the alternating-current generator. The large fly-wheel was replaced by a new one weighing about 15 tons to carry the electro-magnets, the armature frame being placed in the existing fly-wheel pit. This work was carried out during a week-end without interfering with the working of the pit. A recent test in which the haulage-work underground was precisely the same as when driven by compressed air, showed that the indicated horse-power was reduced from 582 to 166 with the electrical system of driving. The surplus power from the converted engine has now been utilized for driving the main-shaft pump, coal-cutters, screens, workshops, and other purposes, thereby saving annually a large quantity of coal.

As regards winding, opinions differ as to whether the use of electricity is advantageous. As conditions and circumstances are important factors in each individual case it becomes impossible to make a general statement or for anyone to express a decided opinion applicable to all requirements. In cases, such as those instanced by W. C. Mountain, when it is necessary to lay down a complete electrical generating-plant for the electrical supply, together with the motors and other machines for conveying power to the winder, it is questionable, having regard to the cost of the plant and the losses in conversion, whether the advantages are sufficient to make the scheme practical and economical. On the other hand, where a suitable electrical supply exists, and there is a margin or provision to prevent entire stoppage in event of the failure of supply, winding by electricity would appear to be worthy of most careful consideration. The danger of failure in the supply is becoming less year by year and the establishment of central stations from which power is distributed for different purposes through mines or even through districts, is becoming more common. Our Continental friends seem to have taken the initiative in installing electrical winding-plants of large size, but we are following suit and some of considerable importance can now be seen in this country, while those of smaller capacity are fairly common. The following are cited as operating on the Continent:

PREUSSEN II. COLLIERY.—The generating station contains three triphase generators, each of 550 kw. capacity at 2,100 volts. The controller proper is of a patent liquid resistance type and the controlling gear is fully adequate. The winder consists of a Koepe wheel 19 ft. 8 in. diameter mounted, together with the rotor of the motor, on a shaft supported by two bearings.

Maximum horse-power ...	2,400
Depth of wind	2,295 ft.
Load	2·16 tons
Tons per hour	100
Winds per hour	46

GRAND HORNU COLLIERY, BELGIUM.—The power-house contains two direct-connected steam-driven triphase generators of 2,000 and 4,000 kw. at 1,100 volts. The motor is direct-connected, as in the Preussen II. plant, but to a pair of drums for each shaft and flat-tapered winding-ropes are used. The controlling arrangements resemble those at the Preussen II. shaft. The winding is from three shafts; the details for two of these are:

Depth of wind	3,300 ft.
Load	2·6 tons
Tons per hour	65
Winds per hour	25

ZOLLERN II. COLLIERY.—The generating plant consists of three triple expansion horizontal engines, each engine having, mounted on its crank-shaft, a direct-current 16-pole generator producing 1,100 kw. at 525 volts when running at 90 revolutions per minute. These generators supply current to the whole of the machinery at the colliery. The winder consists of a Koepe wheel 19·39 ft. diam. with two electric motors, one on each side of the wheel, each of 705 normal horse-power, and they receive their energy from an Ilgner motor-generator.

Maximum horse-power ...	1,650
Depth of wind	984 ft.
(which will be 3,600 ft. later)	
Load	5 tons
Tons per hour	200
Winds per hour	40

WENDEL COLLIERY, WESTPHALIA.—This is probably the largest electrical winding installation in existence. The Ilgner system is used in connection with a Koepe winding pulley.

Maximum horse-power ...	3,000
Depth of wind...	2,950 ft.
Load	5·2 tons
Tons per hour	175
Winds per hour	33

In this country, while we are not so far forward, some important installations are either lately at work or are in course of construction, for example:

COBBINSHAW NO 1 PIT (TARBRAX OIL CO., LTD.)—The power is taken from the power-station at the works. The current is triphase and is supplied through an Ilgner motor-generator. The winding motor is continuous current shunt-wound and is directly coupled to the winding-drums, which are 8 ft. diam. and 2 ft. wide. This is one of the first, if not the earliest, installations of electrical winding of importance in Great Britain; it is relatively small.

Maximum horse-power ...	400
Depth of wind...	420 ft.
Load	1·25 tons
Tons per hour	80
Winds per hour	64

MARITIME PIT, GREAT WESTERN COLLIERY CO.—This takes a current from the South Wales Power Co., the supply being triphase at 2,200 volts. The drums are of the spiral-cylindrical type 7½ to 15 ft. diam. and reduce the peak of the load from 1,450 to 1,000 h.p. by giving an overbalance in favour of the empty cage at the pit-top. This allows of the whole work of the motor at starting being devoted to overcoming the inertia of the masses during acceleration, and, at the end of the wind, provides the necessary negative part for retardation. The control is by means of the Westinghouse converter-equalizer system, a full description of which will be found in papers by Hugh Bramwell and Gerald Hooghwinkel. (Proceedings of South Wales Institute of Engineers, 1908).

Maximum horse-power ...	1,000
Depth of wind	1,100 ft.
Load	2·5 tons
Tons per hour	170
Winds per hour	70

DUFFRYN RHONDDA MINE.—Another large winding plant is in course of construction and almost ready for erection; the electric wind being from 1,500 to 1,800 horse-power.

It will be noticed that, except in the cases of the Zollern II. and Wendel collieries, the loads are relatively small and, in the cases of Grand Hornu and Cobbinshaw No. 1, the times of changing are given at 39 and 30 seconds, respectively, which, of course, compare badly with any modern steam hoisting-plant. In Preussen II., however, the steam consumption per horse-power-hour in coal lifted is only 33 lb., and the official trials of the plant at the Maritime pit showed that when winding at the rate of 70 trips per hour with an average net load of 2·35 tons, the consumption of steam was 28·8 lb. per shaft-horse-power-hour on the assumption that the electric supply, taken from the South Wales Power Co., is generated at 18 lb. of steam per kw.-hr., which is a moderate consumption for modern steam-turbines.

M. B. Mountain says: "A steam winder would probably consume about 35 lb. steam per shaft-horse-power-hour or 20% more than the electric winder," but, in view of the figures quoted by W. C. Mountain, it would seem that these claims for electrical hoisting are modest.

The Origin of Petroleum.—At the recent annual meeting of the Canadian Mining Institute, Eugene Coste returned once more to his favourite theory, the volcanic origin of petroleum. During the last ten years he has made a special study of this subject and has read several papers giving his data and conclusions before the Canadian Mining Institute and the American Institute of Mining Engineers. The present paper presents a useful resumé of his conclusions, and includes additional examples of the occurrence of petroleum that help to bear out his contentions. Mr. Coste divides the subject into two parts; first, a discussion of the geological and chemical differences between coal deposits and petroleum deposits, and second a description of occurrences of petroleum in places where its ultimate origin from coal seems least likely. Briefly stated, his argument against the connection of petroleum with coal is that methane is the only hydrocarbon which is definitely known to be the product of the decomposition of vegetable matter either immediately decaying or fossilised. Consequently, he rules out all other hydrocarbons, gaseous, liquid, or solid, that occur in petroleum deposits, and doubts the possibility of their having been produced from coal. This part of his argument omits any consideration of the effect on coal of physical forces other than those known at the present time.

In discussing the occurrence of hydrocarbons in connection with igneous rocks, the author includes graphite as a member of the petroleum family, and gives the presence of graphite in igneous rocks as an argument in favour of the volcanic origin of petroleum. The most interesting part of the paper is the detailed description of the occurrence of hydrocarbons in igneous rocks. For instance, he quotes the case of the occurrence of oil-wells in gneiss overlying granite in Placerita canyon, Los Angeles county, California, and the occurrence of oil and bitumen in the quicksilver deposits of California. Reference is made to the so-called coals, really solid hydrocarbons, containing vanadium, which occur in Peru, in close proximity to obsidian dikes. He quotes the article by Ezequiel Ordoñez, in the *Mining and Scientific Press* of August 24, 1907, in which the occurrence of oil-wells near Tampico, Mexico, at the base of basaltic tufa cones, is described, and he gives details of the oil geyser close to the Hermanos volcanic hills along the Laguna de Zamiahua. Further arguments are that the force causing oil to gush out has no connection with artesian-well action, and that the occurrence of oil in sandstones is due entirely to the porosity of the stone, which absorbs the oil forced up from below. Mr. Coste gives sufficient argument to make out a good case against the theory that petroleum comes from the decomposition of coal; it is a subject requiring further investigation, and contributions to the discussion are invited bv the author.

CURRENT LITERATURE

MINING AND MACHINERY

Disposal of Tailing.—In the *Engineering and Mining Journal* for July 10, C. K. Baldwin describes Fred Smith's boxes for dewatering tailing at the Wolverine copper concentration mill, on Lake Superior, and also the conveying belt for carrying the dewatered tailing far into the lake.

Method of Mining.—In the *Mining and Scientific Press* for July 17, Stuart R. Elliott gives his experience in applying the caving method. The mine in question was originally worked in large open stopes without timber and the upper part of the deposit was left intact for fear the watery sand above should come in. After the levels were exhausted it became desirable to attack the pillars. This was done by the caving system. To prevent the sand entering and doing damage, a considerable thickness of filling, obtained by blasting rock from the hanging wall, was packed into the stopes.

Placer Examinations.—Arthur Lakes, jr., in the July issue of *Mines and Minerals* describes the method of prospecting with churn-drills, collecting and panning samples, and estimating and recording results.

Cornish Pumps.—*Mining and Scientific Press*, July 10, W. Percy Gauvain discusses some of the views expressed by H. F. Collins in a previous issue. He doubts the soundness of Mr. Collins's claim for the superiority of the single over the compound type, and he gives particulars of the results obtained by the great compound Cornish pump at Waihi, N.Z.

History of the Rock-Drill.—*Mining and Scientific Press*, July 10, S. H. Brockunier points out that Herman H. Haupt was the first to use a rock-drill in successful practice. In the years 1857 to 1862 he employed his machine in the construction of the Hoosac tunnel, in America. Mr. Brockunier's article was written to controvert several erroneous statements that have recently been published.

Stamp-Mills.—The *Engineering and Mining Journal* for July 10, contains a contribution by Mark R. Lamb in which he discusses breakages of cams and cam-shafts, and recommends that the cams should be designed to fit the lift. The cams should raise the stamps more gently and not give blows to the tappet; then there will not be so much likelihood of the cams and cam-shafts crystallising and becoming brittle. The writer is in the employ of the Allis-Chalmers Co., Milwaukee.

GEOLOGY AND ORE DEPOSITS

The Gowganda District, Canada.—*The Canadian Mining Journal* of June 15 and July 1 publishes a description of the Gowganda Mining Division, District of Nipissing, Ontario, drawn from a preliminary report by W. H. Collins, of the Geological Survey of Canada.

Mineral Industry of Mexico.—The issue of the *Mining World*, Chicago, of July 3, deals entirely with the mineral resources of Mexico and the laws regulating operations in the Republic. An excellent map of the country is inserted as a folder.

Wallaroo and Moonta Mines.—In the *Engineering and Mining Journal*, July 10, Gerard W. Williams gives a description of the mine and smelting plant of the Wallaroo and Moonta mines, South Australia. This is not a new mine or smelting plant. A fuller and more authoritative account was given by T. C. Cloud in his paper read before the Institution of Mining and Metallurgy in November 1906 and in April 1907.

History of the Comstock. — To celebrate the jubilee of the discovery of the Comstock silver mines, in Nevada, a number of articles are given in the *Mining and Scientific Press* of July 3. They describe the present practice and recall the history of this celebrated mining centre. Among the contributions may be mentioned: 'Comstock Beginnings,' by J. T. Goodman; 'The Comstock Mines To-day,' by Whitman Symmes; 'Comstock Drainage Problems,' by Leon M. Hall.

China Clay in Cornwall.—In the *Queensland Government Mining Journal* for May, Lionel C. Ball, Assistant Government Geologist of Queensland, gives an account of his personal examination of the method of preparing china clay for market at the Gunheath works, St. Austell, Cornwall.

Mining in Mexico.—In the *Mining and Scientific Press* for July 24, E. A. H. Tays, an experienced mining engineer, gives some account of Northern Sinaloa, a tract of country little known but of future promise as a mining centre.

Charters Towers Goldfield.—In the *Queensland Government Mining Journal* for May, W. E. Cameron, Assistant Government Geologist, gives a report on the present condition of the Charters Towers gold mines and discusses the possibilities at depth.

The Historical Geology of California.—In the *Mining and Scientific Press*, June 19, 26, July 10, 17, William Forstner epitomises in a series of articles the data so far available relating to the geology of California. Up to the present time this information has been scattered through official reports, transactions of societies, and newspapers. Mr. Forstner's summary should prove useful to mining engineers.

The Mineral Resources of Newfoundland.—The *Canadian Mining Journal*, in the issue of August 1, commenced a series of articles on the mineral resources of Newfoundland.

Ray Copper Mines, Arizona.—An article on the Ray copper mines in Arizona, by W. H. Truesdell, appeared in the *Mining and Scientific Press* for June 5. These mines were of too low a grade to pay in earlier days. The successes at Bingham, Utah, and Ely, Nevada, have revived interest in the low-grade copper ores of Arizona. An article on the same subject, by R. L. Herrick, was published in *Mines and Minerals* for July.

Cobalt during 1908.—The *Canadian Mining Journal* for June 1 contains an article by Arthur A. Cole reviewing the Cobalt mining district for the year 1908. This article is of special value, as it gives details of the ultimate destination of the ores, the names of the purchasers, and the terms of sale.

Phosphate Deposits of the United States.—The *Mining and Scientific Press* for July 17 contains an article by F. B. Van Horn on this subject. As a result of the recent 'conservation' movement, the phosphate resources of the country are receiving renewed attention. The deposits in Florida, Tennessee, and Carolina have been worked for many years, but it is only recently that those in Idaho, Wyoming, and Utah have been discovered and worked. The public lands in the last mentioned States, known to contain deposits, have been withdrawn from entry with a view to conserving the resources of phosphoric acid.

The Origin of the Bolivian Tin Deposits.—In *Economic Geology* for June, William R. Rumbold argues from his experience in the Tres Cruces tin district that the geological history of the tin deposits of Bolivia is not so different from the history of other deposits, as Stelzner, Phillips and other authorities have declared.

The Placers of Tierra del Fuego.—In the *Mining and Scientific Press* for July 24, S. H. Loram deals with the history of the working of the gold placers of Tierra del Fuego and gives particulars of companies formed within recent years to operate them.

METALLURGY

Cyanide Practice.—The *Bulletin* of the American Institute of Mining Engineers for July contains a paper by S. F. Shaw, of Los Angeles, entitled 'Review of Modern Cyanide Practice in United States and Mexico,' to be read at the Spokane meeting in September. The paper deals chiefly with fine grinding and cyaniding, especially of sulphide ores, and consists of an outline of information published on the subject in the *Mining and Scientific Press* and other American papers. The subject is too large to be treated in a short paper like this. Probably all metallurgists interested in gold have collected the information in greater detail already for themselves. To others who only follow metallurgy in a general way, the details in the paper are either too elementary or not sufficiently illuminating.

Copper Smelting at Anaconda.—In the *Engineering and Mining Journal* for August 7, C. Offerhaus deals at considerable length with the blast-furnaces at Anaconda. Except that in one case three furnaces are now thrown into one making a total length of 87 ft., as compared with two thrown together making a length of 51 ft., the practice is in no way greatly different from what has been already described in various publications.

Cyanide Practice.—The cyanide plant of the Pittsburg Silver Peak Gold Mining Co., at Blair, Esmeralda county, Nevada, was described by Henry Hanson, mill-superintendent, in the *Mining and Scientific Press* for May 8. The ore and processes used are similar to those at the Homestake mine. Practically the same article by the same author is published in *Mines and Minerals* for July.

The Air-Lift Pump in Cyanide Practice.—In the *Engineering and Mining Journal* for August 7, Leonard M. Green gives a scientific disquisition as to the efficiency of the air-lift used in cyanide plants.

Cyanide Practice.—*Mining and Scientific Press*, July 10. Alfred Merritt Smith gives an account of practice with the Butters slime-filter at the works of the Nevada Goldfield Reduction Co., and explains how the methods were evolved.

Cyanide Practice.—R. F. Coolidge, in *Mining Science* for July 29, gives particulars of the analyses of white precipitates formed in the zinc-boxes of the Kendall Gold Mining Co.'s mill at Kendall, Montana.

Amalgamation.—Elmer Elsworth Carey discusses in *Mining Science*, July 8, the application of electrolysis for improving the amalgamation of gold ores. This is a theoretical article.

Smelting in Utah.—The Tintic custom smelter near Silver City, Utah, is described by L. A. Palmer in *Mines and Minerals* for July. The smelter has one copper furnace and four lead furnaces.

Copper Smelting.—In the *Engineering and Mining Journal* for July 17 and 24, C. A. Heberlein gives some account of the performance of the Magistral smelter at Zacatecas, Mexico, which was designed by the author for the treatment of highly silicious copper ores.

Zinc Smelting.—H. H. Hughes, in the *Mining World*, Chicago, for July 10, describes a proposed revolving retort for distilling zinc ores. Such a retort would be continuous in action and would require less manual labour. Apparently the retort has not yet been used on a practical scale and its applicability to the physical phenomena of zinc smelting is not fully discussed.

Roasting Mercury Ores.—In the *Engineering and Mining Journal* for July 17, W. B. Dennis, manager of the Black Butte Quicksilver Co., Oregon, describes a gas-fired furnace for roasting quicksilver ores. Hitherto he had to use pine and hemlock for heating purposes, and the time of roasting occupied 36 hours. With a wood-gas producer and a more scientific study of heat distribution he reduced the time to four hours.

ASSAYING AND ANALYSIS

Sampling of Cobalt Ores.—In the *Canadian Mining Journal* of July 1, A. R. Ledoux gives an account of his firm's methods of sampling the ores from Cobalt, Ontario, and the reasons why he prefers hand-sampling instead of mechanical sampling on this class of high-grade ore.

The Assay of Arsenic and Antimony.—L. Parry, in the *Mining Journal* for July 31, gives a rapid method of estimating the total arsenic and antimony without separating them.

MISCELLANEOUS

The New York Metal Exchange.—The *Engineering and Mining Journal* for July 31 gives the new rules of the New York Metal Exchange. This exchange lost its usefulness some years ago, when the great producers got into direct contact with consumers, so that the quotations and records ceased to reflect the controlling transactions. The new rules may bring the quotations more into line with the average of actual transactions, but it is doubtful whether they will bring back business to the Exchange.

The Leasing System in Mines.—In *Mines and Minerals* for August, C. W. Burgess discusses the relative advantages of leasing and company operation, basing his arguments chiefly on experience in the Cripple Creek district.

Mexican Mining Laws.—Courtenay De Kalb, in the *Mining and Scientific Press* for July 17, gives a translation of the New Mexican Mining Laws, which are expected to come into force on January 1, 1910.

Methods of Mining.—R. L. Herrick, in *Mines and Minerals* for August, gives full particulars of the caving and slicing systems adopted at the Cananea copper mines in Sonora, Mexico.

BOOKS REVIEWED

PRINCIPLES OF MINING.—By Herbert C. Hoover. 8vo. 195 pages. Ill. Hill Publishing Co., New York and London. Price 10s. 6d. For sale by *The Mining Magazine*.

This book will provoke interest because the author is an American mining engineer who achieved honourable prominence early in his career; it is well worth reading because written by a man thoroughly versed in his subject and evidently willing to express himself frankly. The 20 chapters may be divided into six that are devoted to mine valuation, eight that deal with the work of mining, and six that discuss the administration of mines; in brief, the book describes in a sketchy way the methods of mining and in a comprehensive way the economics of mining. The title, 'Principles of Mining,' is not descriptive of the contents; for this, 'Economics of Mining' would have been better, but the title had already been used in an earlier volume, to which also Mr. Hoover contributed. The preface begins with a ghastly typographical error, the name Stamford appearing for Stanford, the university in California from which the author graduated and before which he delivered a series of lectures now incorporated in the present volume. Without further criticism of details, it must be added that the book would have gained from closer editing and re-arrangement of involved sentences. But readers of technical literature have been so burdened with the writings of those who knew how to write without knowing much more, that it is delightful to receive a book full of first-hand information and enriched with notes taken from the personal experience of a mining engineer who ranks among the first in the profession. In the chapters devoted to the valuation of mines the careful reader will find numerous hints of a most useful kind and many generalisations stimulating to further thought. The position of the engineer as adviser to speculators is made clear, and it is emphasised that the profession can serve the best interests of mining by preventing the misuse of money through the folly or chicanery of either the speculator or the promoter. In analysing the percentage of error in sampling underground, the author gives 12 per cent. as an empirical ratio deduced from the experience of Western Australia, Broken Hill, and South Africa. He then explains the reason for the discrepancy and insists upon the use of some factor of safety, say, 10 per cent. at least. In the second chapter Mr. Hoover takes a characteristic fling at the Institution of Mining and Metallurgy, and at the attempts (highly successful, it seems to us) to standardise technical terms. He makes a plea for that belated survival of ignorance, 'ore in sight,' but he is too sensible to be consistent and himself uses 'proved ore' as a synonym. In the next chapter the question of persistence of ore in depth and the related problem of secondary enrichment are discussed in an illuminating manner. Here the author summarises the practical deductions from current geological theories and presents his conclusions in a way likely to prove immediately useful to the valuers of mines. One of the most suggestive conclusions in the book is the one respecting persistence of orebodies; the author offers the generalisation that "the minimum extension of an orebody or ore-shoot in depth below any given horizon would be a distance represented by a radius equal to one-half its length." Here is room for investigation and thought. In Chapter IV. the variations in the prices of metals as affecting the profit to be won from different mines is discussed, the author incidentally giving some extremely valuable data. Amortisation is explained in the chapter that follows. Inwood's tables are quoted and the redemption of capital is explained. Mr. Hoover performed a similar service in 'Economics of Mining'; he does it now in greater detail and with ampler experience. The chapters dealing with mine development and stoping are well illustrated with explanatory diagrams, which add greatly to the clearness of the description. We like the chapters on administration; they are written by one having authority in these difficult matters, and they are reinforced by facts of an eloquent character.

H. C. Hoover.
(By courtesy of W. T. Pike & Co., Brighton).

In the concluding paragraphs the author dwells with enthusiasm upon the part played by the engineer in the complex civilisation of our day and appeals to the *esprit de corps* of the profession. The tone of the whole book is typified by a sentence appearing on page 52, where the author says: "The engineer's interest is to protect the investor, so that the industry which concerns his life-work may be in honourable repute, and that capital may be readily forthcoming for its expansion." We recommend this volume to students, meaning thereby all those that are willing to learn, especially the men engaged in the business of mining.

T. A. R.

RUSSIAN COMMERCIAL HANDBOOK.—By L. Norrgren. 12vo. 165 pages. Effingham Wilson, London. Price 4s. For sale by *The Mining Magazine*.

This is a useful and convenient handbook, giving the Russian law on bills of exchange, on customs formalities, on stamp duties, on the mining regulations, and miscellaneous commercial matters, prepared by the secretary of the Russian Consulate General in London. In view of the increased interest in the mining development of Siberia, this little volume should be welcome to many English mining engineers.

THE MINERAL INDUSTRY, Vol. XVII. Edited by W. R. Ingalls. 8vo. 1,073 pages. Ill. McGraw-Hill Book Co., New York. Price £2 2s. For sale by *The Mining Magazine*.

This is the statistical and technological yearbook published annually by the *Engineering and Mining Journal* and edited by the editor of that weekly periodical. Started by R. P. Rothwell in 1892 and continued by his successors, this useful summary of statistics, technology, and trade of the mineral industry has won an authoritative position and has become an invaluable book of reference. Every year the statistics of previous periods are revised and brought up to date. This year the book is issued with unusual promptitude, enhancing its value. As usual, the list of contributors includes many notable names, besides those on the regular staff, but chief credit is, of course, due to the editor himself, Mr. Ingalls, who as assistant to Rothwell and as editor of the *Engineering and Mining Journal* has proved himself to be possessed of that insight into statistics and that judgment in compilation so necessary to work of this kind. His own articles on 'Gold Production and Commodity Prices,' 'The Cost of Silver-Lead Smelting,' and 'Zinc,' are authoritative contributions on important subjects, prepared with evident care and presented with practised skill. Among the other important reviews are those on 'The Literature of Ore Deposits,' by J. F. Kemp, who is never dull and always reliable; on 'Ore Dressing,' by Robert H. Richards, who has worthily identified himself with this subject; on 'The Metallurgy of Copper,' by L. S. Austin, the professor of metallurgy in the Michigan College of Mines; on 'Lead Smelting,' by H. O. Hofman, the author of an established textbook on this subject; 'Practice in Mining,' by H. L. Smyth, the professor of mining at Harvard, and a teacher exceptionally successful as an engineer; on 'Tungsten,' by O. J. Steinhart, who gives a concise contribution on a subject of growing interest; on 'Quicksilver,' by H. W. Turner; and a comprehensive review on 'Iron and Steel,' by Frederick Hobart. A number of shorter articles, tables of statistics, and bibliographies on special subjects, all form part of this volume, the general quality of which is fully equal to that of any of its sixteen predecessors.

THE PRECIOUS METALS.—By T. Kirke Rose. 8vo. 295 pages. Ill. Archibald Constable & Co., London. Price 6s. For sale by *The Mining Magazine*.

This is the work of a recognised specialist of the first rank and the author of other metallurgical textbooks of acknowledged usefulness. The author says that his aim has been "to provide an introduction to the study of the precious metals and an elementary book of reference for those who do not wish to pursue the subject further." In this purpose he has succeeded admirably. The book begins with a scholarly summary of the history of gold and then three chapters are devoted to the chemistry of the noble metal. Here the author, who is chemist of the Royal Mint, is on familiar ground and affords his readers first-hand information in a concise manner. A short chapter on the occurrence of gold is a convenient compilation from reliable sources. In the next three chapters the extraction of gold by washing, stamp-milling, and cyanidation are outlined, with convenient references to other writers. Then comes the turn of silver, which receives similar but briefer treatment. The assay of gold and silver ores and of bullion is followed by an account of the minting of these metals and their manufacture into wares. One chapter is devoted to platinum. The last chapter is statistical. Thus it is evident that this handy volume should serve both as a textbook in mining schools and a book of reference to mining engineers; and these are the uses that the author had in mind. The book is well illustrated and excellently printed. We commend it to anyone interested in the 'precious' metals. Who is not?

THROUGH THE YUKON AND ALASKA.—By T. A. Rickard. 8vo. 392 pages. 175 illustrations. Index. *Mining and Scientific Press*, San Francisco and London. Price 10s. 6d. For sale by *The Mining Magazine*.

At the outset of this review I must impress upon readers that 'Through the Yukon and Alaska' is not a reprint of the articles on gold mining in the North that recently appeared in the *Mining and Scientific Press*. This is a book of travel, interesting equally to the layman and to the mining engineer. When Mr. Rickard returned from the North last year, he decided to divide his notes and observations into two parts, the technical and the general. The technical information has been published in the *Mining and Scientific Press;* the general now appears in book form.

There have not been many books published on the Yukon and Alaska. Those written by professional travellers and explorers contain some exaggerations, and their information about the staple industry of the country is not reliable. The present book, written by an authority on mining and a close observer of nature, gives a graphic account of the country and the methods of life. It is interesting to the layman as a book of travel and it is valuable to the intending visitor as a trustworthy description of the region. The book is made additionally attractive by numerous excellent photographs.

The author left Seattle in June 1908, went by rail from Skagway to White Horse, and by steamer to Dawson; then down the Yukon river, by Tanana and Fairbanks, to St. Michael on Bering Sea; then across to Nome on the Seward peninsula and back to Seattle. At several points he made spur excursions. The journey extended over 8,250 miles of land and sea.

The reviewer has read the book as a stranger to the country. Probably the readers of *The Mining Magazine* will be in the same position, so a few references to interesting points may be helpful. The usual idea of Alaska is that it is a rocky tract of country full of snow and glaciers. The real facts are that while the south-eastern part possesses these characteristics, the remainder of the country is comparatively flat and dry. The warm winds of the Pacific, on reaching the mountain ranges on the coast, deposit their moisture in the form of snow. In the summer the atmosphere is misty and wet. Glaciers are found in all the valleys; they drop into the sea, and the smaller pieces are caught and utilised in many ways. This range of mountains is not more than 30 miles wide and after once crossing them the air is found to be quite dry; in fact, in most of the gold-gravel districts, the scanty rainfall causes an inconvenient insufficiency of water. Farther north, the ground is perpetually frozen and the rich gravel on bedrock (40 ft. deep) is mined by shafts and drifts, while the surface is covered with 'tundra' or moss. The interior heat of the earth is not sufficient to help the summer heat of the atmosphere to thaw the frozen gravel. At one place, however, between Fairbanks and Tanana, there are hot springs where the water issues at a temperature of 135° F. In this vicinity the condition of the earth is naturally different, and the ground forms a hotbed for vegetables.

The author gives an account of the breeds of dogs used for transport across the wilderness, and he follows this with a vivid description of the great dog race, which is the Derby of Alaska. The Eskimo receive sympathetic treatment, as also the Thlingits and other Indians on the south-eastern coast.

A glimpse of Alaska.

One of the most interesting chapters is that giving the history of the old Russian settlement at Sitka, on Baranoff Island, where the ikons of the Greek Church are found as near neighbours to the totem-poles of the Indians. Mention must also be made of the accurate data given by the author concerning the discovery of the various gold districts, and the comparisons of present and former methods of travel and transport. The photographs and accounts of the stampedes of ten years ago, the doings of Soapy Smith's gang of ruffians at Skagway, and the privations of the 'musher,' or mining tramp, give a vivid idea of the "old days." The account of the anarchy at Nome in 1900 is a bit of real and significant history. The methods of mining are described in not too technical language and are therefore within the grasp of the ordinary reader, but though they are primarily intended for the layman, they are of great value to the mining engineer who wishes to gain a general idea of the local practice. And beyond the information concerning the mining, geography, ethnology, and politics of these northern regions, the reader will find delightful verbal pictures of the scenery and the people, touched with warm, human interest and brightened by a skilful pen.

E. W.

TIMBERING AND MINING.—By William H. Storms. 8vo. 275 pages. Ill. McGraw-Hill Book Co., New York. Price 8s. 6d. For sale by *The Mining Magazine*.

This is an amplification of the bulletin prepared by Mr. Storms in 1892 when in the employ of the State Mining Bureau of California. Owing to the success of that bulletin, which was entitled 'Methods of Mine Timbering,' it was re-printed and revised for a second edition in 1894. Subsequently, the demand for copies exceeded the supply, which was gratuitous, so that the treatise has been unobtainable for several years. Thus the author was well advised in preparing another version of his contribution to such an important subject, on which, it may be added, no altogether satisfactory literature has been available, despite various half-hearted attempts on the part of other writers. The author is a practised writer, having been editor of the *Mining and Scientific Press* for two or three years preceding 1906; he is also a practical miner, having had charge of mines in California; therefore Mr. Storms is well qualified to teach others how to place timbers in openings underground. The book itself is illustrated with useful drawings and diagrams; the practice described covers American methods in the Western States generally, in the iron regions, in the Homestake mine, together with references to Kimberley and Broken Hill. As a treatise it is defective in omitting a description of the work done in the Alaska Treadwell and in the big copper mines of Lake Superior, for, in both localities the mining methods are peculiar and instructive, as much by avoiding the use of timber as in the intelligent employment of other means of holding ground. However, Mr. Storms gives so much useful information, most of it at first hand, that the reader will forgive these omissions and appreciate the practical hints so freely scattered through these pages. This is undoubtedly the best book on mine-timbering.

T. A. R.

TRANSACTIONS OF THE INSTITUTION OF MINING AND METALLURGY. — Eighteenth Session. Vol. XVIII. 1908—1909. Octavo. 510 pages. Ill. Paper Cover. Published by E. & F. N. Spon, Ltd., and by the Institution of Mining and Metallurgy, London. Edited by Arthur C. Claudet, S. Herbert Cox, William Gowland, and C. McDermid. Price 21s. For sale by *The Mining Magazine*.

This record of the papers and discussions read and delivered at the meetings of the leading mining association of London contains much matter of technical and general interest. Among the most notable are 'Reinforced Concrete Foundations for Stamp Batteries,' by S. J. Truscott; 'Working Costs on Mines,' by John A. Dennison; 'A Theory of Volcanic Action and Ore Deposits,' by Hiram W. Hixon; 'Shrinkage Stoping in Western Australia,' by F. Percy Rolfe; 'Valuation of Mining Areas on the Rand,' by W. Fischer Wilkinson; 'The Wholesale Idea in Mining,' by W. R. Feldtmann; 'The Computation of the Present Value of Developed and Underground Mines,' by W. H. Goodchild; 'An Instance of Secondary Impoverishment,' by Henry H. Knox. Some of these papers gave rise to vigorous discussion, the value of which was in several cases disproportioned to its length. That prompted by Mr. Hixon's theories on ore deposits was decidedly unscientific and contributed but little to geological knowledge; Mr. Hixon raised several nice points in geo-physics, but neither he nor his hearers seem to have been prepared to tackle them. On the other hand, the debate arising from the three papers on mine valuation was both practical and interesting; here the members were on safe ground and were able to demonstrate that science is organized common-sense. Indeed, the 80 pages devoted to this subject constitute the core of the volume from a technological standpoint. The Transactions are well printed and fairly well edited, but there is an excess of irrelevant matter and a record of trivialities that might as well be omitted from the record. Many of the titles of papers are ill chosen; they are both too long and non-descriptive; let the reader try and index some of those quoted above. T. A. R.

NEW PUBLICATIONS

TRANSVAAL CHAMBER OF MINES.—Nineteenth Annual Report. Published in England by the London office of the Chamber, Salisbury House, E.C. Price 21s.

MAP OF WEST AFRICAN GOLDFIELDS, through the Banket Range. London: Richard Mayer, 50 Holborn Viaduct. Cloth, 10s.; paper, 7s. 6d.

THE PRECIOUS METALS, COMPRISING GOLD, SILVER AND PLATINUM. By T. Kirke Rose, Chemist to the Royal Mint. London: Archibald Constable & Co., Ltd. Price 6s.

IGNEOUS ROCKS; their Composition, Texture, and Classification. By J. P. Iddings. New York: John Wiley & Sons. London: Chapman & Hall. Price 21s.

HANDBOOK FOR FIELD GEOLOGISTS.—By C. W. Hayes, of the U.S. Geological Survey. Second Edition. New York: John Wiley & Sons. London: Chapman & Hall. Price 6s. 6d.

HISTORY OF THE CLAY WORKING INDUSTRY IN THE UNITED STATES.—By Heinrich Ries and Henry Leighton. New York: John Wiley & Sons. London: Chapman & Hall. Price 10s. 6d.

HANDBOOK OF AMERICAN MINING LAW.—By C. P. Costigan. St. Paul, U.S.A.: West Publishing Co. Price $3.50.

RAPID ASSAYING FOR MINING ENGINEERS.—By S. M. Lecuona. London: *The Mining Journal*. Price 2s. 6d.

MINES IN THE TRANSVAAL.—By R. R. Mabson. Second Edition. London: *The Statist*, 51 Cannon St. Price 15s.

HANDBOOK OF TACHEOMETRICAL SURVEYING.—By C. Xydis. London: E. & F. N. Spon. Price 6s.

INDEX OF MINING ENGINEERING LITERATURE.—By Walter P. Crane. Professor of Mining at the Pennsylvania State College. New York: John Wiley & Sons. London: Chapman & Hall. Price 21s.

This book contains about 800 pages of references to articles on mining and metallurgy, chiefly those in American journals and transactions. The subject is divided into 50 different headings, such as sampling, sizing, signalling, surveying, transportation, tunnelling, ventilation. Some of the references go back to the commencement of the publications indexed, for instance, the American Institute of Mining Engineers. Most of the other journals and transactions are only partly indexed. The references contain the title of the article, the name of the author, the length of the matter, and the date or volume of publication. No information as to the nature or value of the articles is given. An article that appeared 13 years ago entitled 'Improvements in Gold Extraction' is not now sufficiently described by its title. What information is to be expected from this entry: "Sulphurets, M. & S. P. Vol. 25 p. 210 1/3 col."? Such indexing is of no value; to be useful the references must be complete and the seeker after information must be given a clue to the value or authoritativeness of the writings recorded by the indexer, otherwise he will find himself chasing rainbows of unreal knowledge.

SECOND APPENDIX TO DANA'S NEW SYSTEM OF MINERALOGY.—By E. S. Dana and W. E. Ford. New York: John Wiley & Sons. London: Chapman & Hall. Price 6s. 6d.

This book contains an account of the progress in the science of mineralogy from the issue of the first appendix in 1899 to the year 1909.

NON-FERROUS ALLOYS.—By A. Humboldt Sexton. Manchester: The Scientific Publishing Co. Price 7s. 6d.

ANNUAL REPORT OF THE DEPARTMENT OF MINES, NEW SOUTH WALES, for the year 1908. Obtainable at the Agent-General's office, 123 Cannon St., London, E.C.

REPORT ON THE MINES AND MINERAL RESOURCES OF COLOMBIA.—By Francis Stronge. London: Wyman & Sons. Price 4½d.

This report is one of the series of British Consular and Diplomatic Reports, and is written by His Majesty's Minister at Bogota. It contains informa- about the chief mining districts and a summary of the mining laws. A map of the country is appended.

TIMBERING AND MINING.—A treatise of practical American methods. By William H. Storms. New York: McGraw-Hill Book Co. Price 8s. 6d.

THE MINERAL INDUSTRY for 1908. Edited by Walter Renton Ingalls. New York: McGraw-Hill Book Co. Price 42s.

THE GEOLOGY OF ORE DEPOSITS.—By Herbert H. Thomas and Donald A. MacAlister. London: Edward Arnold. Price 7s. 6d.

This book is the second of Edward Arnold's new geological series, Gibson's geology of coal mining being the first. It is intended to issue succeeding volumes relating to the geology of quarrying, water-supply, and precious stones. The present volume has been written by two members of the Geological Survey. English official geologists and societies partly supported by the Government, are not encouraged to discuss the commercial aspects of ore deposits, so that the present book deals rather with the scientific than the economic side of the question. The book contains a concise account of the origin, mode of occurrence, and classification of metalliferous deposits, and can be recommended to the student.

THE LEAD AND ZINC PIGMENTS.—By C. D. Holley. New York: John Wiley & Sons; London: Chapman & Hall. Price 12s. 6d.

This book gives a history and methods of the manufacture of lead and zinc pigments in the United States.

THE MINING LAWS OF CANADA.—By A. B. Morine. Toronto: Canada Book Co. Price $7.50.

This book is specially welcome, as the absence of a suitable book on the subject has for long been a matter of comment.

THROUGH THE YUKON AND ALASKA.—By T. A. Rickard. San Francisco: Mining and Scientific Press. London: *The Mining Magazine*. Price 10s. 6d.

TRANSVAAL CHAMBER OF MINES.—Nineteenth Annual Report for the year 1908. Johannesburg: *The Transvaal Leader*.

Besides comprehensive statistics, this volume contains the report of the annual general meeting, the new mining laws, an account of the stope-drill competition, and other valuable information concerning the mining industry of the Transvaal.

The Mining Magazine

Vol. I LONDON, OCTOBER, 1909 No. 2

Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager

PUBLISHED (BY THE MINING PUBLICATIONS LTD.) at 819 SALISBURY HOUSE, LONDON, E.C.

Telegraphic Address: Oligoclase. Telephone: 8938 London Wall.

BRANCH OFFICES: SAN FRANCISCO, 667 HOWARD ST.; CHICAGO, 934 MONADNOCK BDG.; NEW YORK, 500 FIFTH AVENUE; MEXICO CITY.

AGENTS FOR THE COLONIES: GORDON & GOTCH, LONDON, MELBOURNE, ETC. (SOUTH AFRICA: CENTRAL NEWS AGENCY, LTD.)

SUBSCRIPTION RATES.

United Kingdom, 12 Shillings (Single Copies 1s.) ... ... Abroad, 16 Shillings (Single Copies 1s. 4d.

CONTENTS.

REVIEW OF MINING

At the end of a summer that was "merely English winter painted green," the City has put on a look of greater animation. The mining market is lively but not excited, recent speculative activity being fairly distributed over the West African, South African, and Rhodesian departments. On September 20 the royal assent was given to the Act creating a unified South Africa. This is an event of far-reaching significance; it will stimulate the industrial development of the mining regions between the Zambesi and the Cape, and it constitutes the confirmation of a political magnanimity highly honourable to Great Britain. Previous to his departure, General Botha made some important statements on the labour question. The Premier of the Transvaal expressed his conviction that sufficient labour would be forthcoming for all local needs, and he deprecated the anxiety caused by the seasonal migration of the natives. Under the Union there is to be a uniform policy for the betterment of the natives, and this is expected to render the labour conditions more stable. This authoritative utterance is particularly satisfactory having regard to the fact that General Botha, Dr. Jameson, and Sir George Farrar have undertaken to act together against any reactionary policy. The note of confidence with regard to labour comes at a good time, for it is obvious that there will be an increasing demand for workers. On September 30 only 3204 Chinese remained in the Transvaal. Within the last six weeks fully 1000 new stamps have been ordered, notably the 600 for the Randfontein Central and the 200 for the City Deep. Further, the Crown Mines is to erect 160 stamps more and the Main Reef West has 40 under way. The weight is being increased so that stamps of one ton appear a near possibility; those ordered for the City Deep weigh 2000 pounds and are expected, by the aid of 9 tube-mills, to have a duty of 11 tons. Even this is likely to be exceeded, for the new mill of the West Rand Consolidated gives a duty of 15 tons per stamp of 1850 pounds. Elsewhere we publish a letter on Rand metallurgy; we have also been informed that our reference last month to the early filter-pressing on the New Goch and Meyer & Charlton was not accurate; for it is claimed that the Dehne presses were an economic, as well as a technical success, although Mr. H. S. Denny is satisfied that for clean slime the vacuum-filter can be operated more cheaply than machines of the pressure type, and that it will prove a decided improvement over the decantation system. An enquiry into this matter is now in progress on the initiative of Wernher, Beit & Co., who have retained Mr. F. L. Bosqui, the American specialist.

Rhodesian mines have afforded opportunity for some feverish gambling, confined to a limited number of shares and to a small group of speculators. Selukwe has fluctuated according to contradictory and imperfect news concerning the condition of the mine. On the whole the Rhodesian companies are lacking in consideration for the anxieties of shareholders and sometimes this evokes suspicions that are not really warranted. Globe & Phœnix has published further information of a decidedly encouraging character as to development in depth. We have been assured that the supposed delay in publishing news from this mine is without reasonable basis; the cutting of the vein below the dyke was announced in April and details as to assays were cabled as soon as the information was conclusive. The pegging of claims in the Abercorn district is now over and actual mining is in progress. The Shamva group, which adjoins the Cymric, is also under option to the Consolidated Gold Fields and active development on both is being pushed with a view to testing the value of the deposit; two adits have been started into the steep hillside, exposing an enormous body of gold-bearing conglomerate. It is a 'banket' formation without doubt and can be worked as a quarry to a depth of three hundred feet.

The West African market has been stimulated by financial rather than mining factors, the recent injection of fresh capital by important houses having been of greater immediate importance than actual news from the mines. The only significant information relates to the Ashanti Goldfields, where 20 ft. of 24 dwt. ore has been exposed in Justice's Find at 300 ft. Meanwhile the critics are slapping the mosquito and emphasizing the necessity for greater attention to the health of employees. Something can be done, but the Gold Coast will never be a health resort; a Turkish-bath atmosphere must be enervating, and with the best of care the white man will suffer from diminished vitality. This can be retarded, but not obviated; already the majority of men in West Africa live better and take more care of themselves than formerly. Some people take bad climates with them, in the form of intemperance and laxity; but these tend to diminish in every mining region as it recedes from the frontiers of civilization.

Travel in West Africa. W. J. Loring in a hammock supported from the heads of four natives.

Our Melbourne letter will be found interesting. The decadence of gold-quartz mining in the districts to which Australia owed its fame is not compensated by discoveries elsewhere, and it is obvious that the mining of the baser metals is gaining relatively in importance. But the lead and copper also contribute an output of precious metal as an important by-product, so that the decrease in the production of gold and silver is checked. A new find in the central desert region has excited attention, and may prove important in itself, as well as a stimulant to widespread exploration.

In Western Australia the Sons of Gwalia on the upper levels has opened up a continuation of the orebody discovered several months ago on the No. 7 level. This orebody is west of the main lode and promises to extend for the depth of several hundred feet, thereby adding largely to the life of the mine. The main shaft is now below 2300 feet. At Kalgoorlie, the Boulder Main Reef and Chaffers have consolidated, but not without local opposition. It is anticipated that further amalgamation will follow, with Hannan's Star and Boulder Deep Levels, the four companies becoming one organization, with a large prospecting area, which can be explored advantageously from the Boulder Main Reef shaft.

Thrifty mine managers have reason to fear the steadily increasing cost of fire-wood and water in the interior of Western Australia. A recent rise of six-pence per ton in the price of fire-wood (23s. per cord of 35 cwt., chiefly eucalyptus) has coincided with an advance in the price of water from 5s. to 7s. per thousand gallons. The Government, which provides the water through its big pipe-line and pumping plants, finds that its customers are fewer, because new mines are not replacing those that have been shut-down; at the same time the cost of maintenance is increasing as the equipment becomes older. The cost to the Government is 9s. per thousand gallons, for the water scheme is a white elephant that originated from a mixture of flamboyant optimism and corrupt politics, but it is only fair to add that the water-supply has proved of the greatest service to the mining industry.

At Broken Hill everything is quiet. The South Blocks has begun unwatering the south shaft with a view to starting a drift north from the bottom to connect with the main shaft, which is being sunk to meet it. The ore in the No. 4 level has extended farther south than on any upper level. Announcement of the particulars relating to the reconstruction of De Bavay's treatment company is anticipated, the funds required for an enlarged scope of operations having been obtained in London chiefly, but also in Australia. All the big dumps at Broken Hill have now been secured on behalf of various concentration companies using modifications of the flotation process. This will lead to a temporary increase in zinc and lead production, so that those not inside the ring will find difficulty in disposing of their spelter.

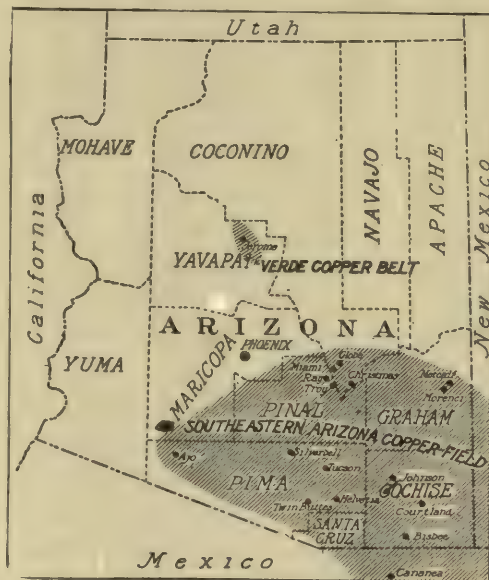
In Queensland the Great Fitzroy has started a new furnace, adding largely to the capacity of the plant, with satisfactory results. An additional furnace has been ordered, the intention being to treat 18,000 tons of crude ore per month. Recent developments on the 300-ft. level show ore ranging from $2\frac{1}{2}$ to 6% copper and $3\frac{1}{2}$ dwt. in gold per ton. Great Cobar has been the subject of much discussion, not wholly technical. We publish some comment from our Melbourne correspondent.

Developments are satisfactory at the mines in the Kolar district of India, and the yearly reports now due will present favourable features. The strong position of the Mysore is becoming emphasized; the deepest developments show veins 3 ft. wide and assaying $1\frac{3}{4}$ oz. per ton. The reserves of ore, amounting to one million tons, are sufficient to supply the mill for four years. Before long the equipment of the new Edgar shaft will be completed, and then substantial economies will be effected by the increased facilities for taking employees to and from their work. At the Dharwar Reefs mine, in Bombay, the developments have been disappointing and the ore reserves are practically exhausted. The managers, however, consider that exploration at greater depth should be undertaken, their previous experience indicating that veins in the schist belt are subject to decided alternations of richness. The remodelled cyanide plant is now ready for operation and will be used for the treatment of accumulated tailing.

At the Hosur mine in the same district a trial run has been made and it has been found that the ore is amenable to the system of treatment adopted in the Dharwar Reefs mill. In the Anantapur district the exploratory work has not been hitherto of a favourable nature, but lately rather better reports have come from the North Anantapur, where, at the 150 ft. level, 180 ft. of ore 4 ft. wide assaying 2 oz. per ton has been developed. Most of the ore in this district is lean, with here and there a bunch of better quality, and the present discovery is therefore decidedly encouraging.

In Mexico the option on the Santa Gertrudis mine, at Pachuca, to the Camp Bird company, has been confirmed by the Mexican shareholders of the property. The option expires at the end of December; this gives plenty of time for the arrangement of details, chiefly legal technicalities arising from the *avio* contracts, which are common to old mines in Mexico. At El Oro, the Esperanza offers several interesting features; the latest developments suggest that the west vein-system may connect with the sulphide ore-bodies interrupted by the faults, three of which characterize the geological structure in this mine. Thus there are possibilities of a continuity of ore occurrence, such as, with a little miner's luck, would add considerably to the life of the mine. The Esperanza has had several ups and downs. We publish a summary of the El Oro report, from which it will be noted that work in the old 100-stamp mill is likely to be discontinued shortly, because the new 100-stamp mill is able by the aid of tube-mills to crush the entire output. The stamp-duty has been increased steadily from 4 to nearly 10 tons per stamp.

The New York mining market appears to be very much alive, despite the attractions of a gamble in Steels and railroad shares. Cobalt mines are to the front, owing to dividends declared by the three leading companies, and it is apparent that this district in Ontario is gaining in productiveness. Meanwhile, the unsanitary conditions prevailing in the town of Cobalt have produced an epidemic of typhoid sufficiently serious to affect local industry. In copper shares there is continued speculation, especially in the mines characterized by chalcocite disseminated through masses of monzonite porphyry. Enormous fortunes have been made during the last two or three years



The Arizona Copper Region.

from this class of copper mines in Utah, Nevada, and Arizona. In the last of these States the development of huge reserves of low-grade ore is such as to assure Arizona the first place as a copper-producing region and to threaten the market with a flood of cheap metal. Soon the big producers will be spoiling their own market.

Our Colorado correspondent refers to an important gold discovery in the White River plateau and we are now informed that carload shipments of 2 oz. ore have been made from a 2½ ft. vein in the schist. In Alaska there has been a 'stampede' to the Innoko region, which is tributary to Fairbanks. This portion of the interior has been the scene of 'excitements' before now, but the new finds on Iditarod creek appear to be in the form of shallow alluvium rich enough for individual mining. The Yukon Gold Co. has announced its first dividend, at the rate of 8% per annum. S. R. Guggenheim, the president of this heavily capitalized corporation, states that operations as yet are only on half the full scale and that next summer, by the aid of the new ditch system, the entire plant will be utilized to a productive purpose. The gold-bearing gravels exploited by this company are on the creeks tributary to the Klondike, near Dawson, in the Yukon Territory. As a mining enterprise the Yukon Gold is interesting on account of its proximity to the Arctic Circle, as an illustration of the skilful application of technical methods to frozen alluvium, as the sport of rainbow finance, and as a survivor of the tender attentions of Mr. Thomas W. Lawson, of Boston.

Ontario continues to be the most promising mining region of Canada. Cobalt has survived the ordeal of a busted boom and is now making substantial progress. The newer mining districts of Gowganda, Miller Lake, Elk Lake, and Sturgeon Lake are full of promise, despite the exaggerations inevitable to periods of industrial excitement. Throughout the length and breadth of Ontario the prospector is at work in eager and intelligent search for mineral wealth. In Quebec, the successful flotation of Amalgamated Asbestos marks the growth of a mineral industry peculiar to the Province and the application of the latest financial methods. It is doubted whether this over-capitalized scheme will prove a blessing to asbestos mining. Quebec still dominates the asbestos trade of the world. Farther west, in British Columbia, the mines and smelters are prospering. It is a quiet progress, unmarked by pyrotechnics. The re-organization of the Dominion Copper Co. and the renewed interest in stamp-milling on Sheep Creek are items worth recording. Coal mining in British Columbia is feeling the stimulus due to the building of the Grand Trunk Pacific railroad and is benefitting from the natural growth of Western Canada.

In South America new gold mining territory is being opened up by the construction of a railway across the Andes from Paita, on the Peruvian coast, to the headwaters of the Amazon. On the western slope of the Cordillera this railway goes through a region rich in oil and sulphur, and on the eastern side it taps gold-bearing gravels, such as those of Utubamba, which may afford a new scope for dredging. Lower down on the San Lorenzo river are placers from which the early Spanish adventurers won gold, as well as alluvial deposits amenable to modern hydraulic mining. Other parts of this continent are attracting renewed attention, notably Brazil, where the old Sao Bento mine is under option to an English firm, and Patagonia, where dredging for gold is making head-way. Prospecting for oil in the coastal regions of Peru and Ecuador has been rewarded by several richly productive wells and there is reason to expect that the development of these fuel resources will stimulate industry in general along the Pacific coast of Spanish America.

Attention is being called to tin deposits in northern Nigeria. Exploratory work by the engineers of the Niger Company indicates the existence of alluvium rich in tin, but actual mining has been hindered hitherto by inter-tribal fights and by lack of transport. Both of these hindrances will shortly be removed, the one by the pacification of the country and the other by steamer and railroad facilities. The centre of the coming tin mining region is Naraguta.

EDITORIAL

IN PUBLISHING a description of the Murex process we desire to express disapproval of the manner in which this metallurgical invention was used as a counter for Stock Exchange speculation before the process itself had been properly demonstrated. Proceedings of this sort create the impression that the process is only an excuse for a market gamble and that it is not sound technically. Such an idea would be wholly erroneous. To harbour any doubt as to the legitimate nature of the business from a technical standpoint would be unfair to many honourable men, who were in no way involved in the tactics to which we have taken exception.

ELSEWHERE in this issue we publish an unpretentious article on smelting in the Argentine. This useful contribution describes the troubles and tribulations incidental to the reduction of copper ore in a remote corner of South America. The scale of the operations was small and the metallurgical data are not remarkable; it is no Anaconda plant or Steptoe equipment that Mr. C. H. Jones describes, but we venture to believe that his story of difficulties overcome will prove interesting to professional men. Technical literature is liberally supplied with the records of the big successes and the crowning achievements of metallurgy, what we need is a few more details concerning the failures, especially of that high failure that o'er-leaps the low success. We do not wish to put a halo round a fiasco; what we have in mind is the conquest of natural difficulties and the application of technical skill to conditions as they were presented to men who knew when a proper trial had been made and were sufficiently well advised not to throw good money after bad.

OUR CORNISH correspondence has elicited diverse criticism; some of it quasi-humorous, as in the *Mining Journal*; some of it is serious, as from Mr. William Thomas. There never was a discussion of Cornish mining affairs that pleased everyone in the 'old county'; a prejudice exists in West Cornwall against ventures "east of Truro bridge" and this prejudice is returned with interest by those who dwell out of sight of Carn Brea. We shall be glad to receive criticism and, when such criticism is of public interest, to publish it; meanwhile, protecting our correspondent under the time-honoured cloak of anonymity, we deem it proper to inform our readers that he is a Cornishman, a mining engineer, and a man of the world, thoroughly qualified to give them trustworthy information and judicious comment upon the mining affairs of the 'delectable Duchy.'

ADDRESSES delivered by presidents of technical societies ought to be highly illuminating utterances, worthy of preservation in the archives of the profession; and if they usually fail to have more than ephemeral interest we impute the deficiencies to the lack of such mental habits as enable men to express the reflective experience of their lives. Such is not the case with Mr. David W. Brunton, the president of the American Institute of Mining Engineers, whose presidential address appears in the latest bulletin of that society. Mr. Brunton is an engineer most happily fitted to be the titular chief of the mining profession in America, for a career of multifarious usefulness has been crowned both by the personal good-will and the financial endorsement of the community in which he lives. On another page we publish an abstract of the paper on ore-sampling recently contributed by him; it serves to illustrate some of the qualities that have given him a worthy reputation as a man who applies technology to business and economies to mining so as to render both honourably profitable. However, it was the presidential address, rather than its author, to which we intended to draw attention. It is a masterly summary of mining and metallurgical progress; although the title refers to the Western United States the address covers not only the western portion of America but, by inference, the modern world, for, almost needless to say, the tide of progress reaches to other shores besides the eastern rim of the Pacific or the western margin of the Atlantic; the waves of economic advancement have broken into the distant creeks and far corners of the world, washing off the dust of custom and vitalizing the atmosphere of even the most archaic communities. Thus in reading Mr. Brunton's resumé of the technical improvements introduced into Western practice we are impressed with the fact that much of this American progress is only a local manifestation of a cosmic process; we do not depreciate the one by including it within the other; and, of course, we yield to none in a keen appreciation of the tremendous impetus given to the technique of mining and metallurgy by American initiative.

THE BRAKPAN MINE in the Transvaal has recently afforded an example of skilful surveying, constituting a technical event of unusual interest. On August 28 the connection was made between two shafts 4428 feet apart. Some of our readers are aware that Mr. F. G. A. Roberts, the manager of the Knight's Central mine, has invented a method of surveying deep shafts, using a number of plumb-lines and determining the mean position underground by casting a shadow of the lines on a screen. By this ingenious scheme the swing is apparently magnified so that the extremes are readily ascertained. The method so commended itself to Mr. Charles B. Brodigan, the manager of the Brakpan mine, that the latter engaged the former to survey the line needed to make the incline connection. The No. 1 shaft was sunk vertically to 3100 feet, reaching the lode nearly a year before the No. 2 shaft, which cuts the lode deeper on the dip at a vertical depth of 3700 feet; consequently the incline connection downward from No. 1 was started long before the corresponding incline upward from the No. 2 shaft was commenced. The necessary survey was completed by Mr. Roberts in 12 hours, not including office work, and during that time he made no less than 16 determinations of a line between plumb-bobs. From these observations the bottom line was calculated and the work of completing the connecting incline was begun. Two months later another series of plumbings was made in order to check the earlier survey, and the new determination only differed by seconds of arc. The work of running the lines along the connecting workings was performed by Mr. L. D. Normand, the mine surveyor. It was all well done, for when the connection was completed it was found that the lines of the top and bottom portions of the incline were only ¾ inch out, and the levels were exactly true. As the work approached completion it was not possible to hear the drills at work from the No. 2 workings because that shaft had been drowned a couple of months earlier by a flood, but it was known that above the water at the upper end of the incline from No. 2 there must be imprisoned air under pressure; therefore in drilling the last round of holes the precaution was taken to carry forward a 15 ft. advance hole, which pierced the intervening rock and permitted a big rush of air to escape. This continued for four hours; then the cut was blasted, and air came out of four holes, promising a good connection. Then six more holes were blasted, opening a width of about 8 feet through which the engineers clambered, to find their most hopeful anticipations fully realised.

Mining Royalties.

In the recent issue of the 'Records of the London and West Country Chamber of Mines' we find some sensible remarks on the Chancellor of the Exchequer's proposed tax upon "ungotten minerals" and the later proposal to tax mining royalties. It is claimed by our West Country critic that the new tax will fall not upon the landlords but on the parties working the mines, because the 'lords' will demand bigger royalties to meet the new tax. To an observer not familiar with local customs it does seem unreasonable that burdensome royalties should be paid, not to the State nor to those owning surface rights, but to a landlord who may have done nothing to develop either the surface or the mine. We simply criticize a custom that looks like a belated anachronism. It is also a curious anomaly that while the law gives the owner of the land the right to the tin, copper, or lead within his boundaries, it reserves the gold and silver to the Crown. Hence the term 'royal' metals. The owners of mineral land can either prohibit the extraction of ore needful to industry or they can impose conditions so exacting as to cripple successful mining. Thus Dolcoath, the premier mine of Cornwall, is worked under lease from the Tehidy estate, to which the operating company pays royalties equal to one-fifteenth of the receipts from the sale of mineral, without regard to the cost of production. Since the commencement of operations under limited liability law, Dolcoath, in 14 years, has sold black tin valued at £1,891,300; out of this the lord received £100,255 and the shareholders, £453,396; the rest went for expenses. At the present time the lord gets £10,000 per annum, while the 2000 shareholders receive aggregate dividends of £17,000 per annum. Formerly the company paid the lord one-eighteenth of the receipts from ore, but three years before the termination of the last lease they went to him for an extension, which was only granted on three conditions, namely, the cancellation of the three years remaining, the increase of the royalty from one-eighteenth to one-fifteenth, and the payment of a 'fine' or premium of £40,000. It is fair to add that in a few cases the 'lords' have waived dues during bad times, but this has been done without legal compulsion, as a politic concession. Besides royalties the lords impose onerous conditions as to the sinking of shafts and the disposal of machinery; that is why Cornwall is thickly dotted with those abandoned engine-houses which in their gaunt ruin give this part of England a look so desolate as to depress even the most optimistic among miners. Our contemporary *The Statist* recently published a thoughtful article on this subject, making clear that the "archaic methods of arrangements between workers and landlords" have prevented responsible capitalists from "engaging in mining in Cornwall on a large and bold basis." In default of drastic legislation *The Statist* suggests that the landlords participate in the mining venture by receiving vendor's shares in return for a lease, renewable without any 'fine' or premium. This can be done if the landlords are reasonable; obviously it is to their interest to encourage the exploitation of mineral deposits, because the surface is mostly moorland capable of scant cultivation, and most of the owners also own ground in the neighbouring towns, the prosperity of which suffers from the decline of the staple industry.

Institution of Mining and Metallurgy.

The proximate annual nomination of members to the Council of the society that represents the mining profession in the British Empire is an event calling for more than incidental comment. During the last ten years the Institution has done good service in many directions, and has thereby gained an influence that should make for greater usefulness in the future. The Institution has reached a stage of growth when careful culture is necessary; it is at that awkward age, through which all engineering associations pass in the course of development, when the dominance of a coterie endangers the corporate vitality. Technical societies depend at their inception upon the activities of a few men, sometimes one only; in course of time affairs pass naturally into the hands of these originators and their friends; if they are men of ability and public spirit they attract the support of a larger circle, until at length a representative society is developed. At this stage the foundations of the social structure are widened so that it may stand four-square to the vicissitudes of time.

These are generalities; let us be more precise. At present the government of the Institution is in the hands of a Council, consisting of 41 members, headed by a President chosen by a sub-committee of the Council. With rare exceptions, the men chosen as presidents have been conspicuously worthy of nomination to the titular leadership of the profession, and, with similarly rare exceptions, the Council has been composed of first-rate men. But the Council is not representative of the whole membership of the Institution. If a man be fit for membership in the Institution, he is fit to be on the Council; the latter should be representative, rather than select.

In most societies the Council is elected for a specified term of years; at the end of this term the councillor is ineligible for re-election until a year has lapsed, so that even the most popular man steps out of office at regular intervals. Usually the president, on the expiration of his term of office, falls back into the ranks; after a year, however, he is again eligible for the Council and he may even be re-elected president, if special circumstances warrant. In any event, there is a healthy circulation of those holding office, not a tenure in perpetuity. By the laws of the Institution every president, when his term ends, becomes a perpetual member of the Council. As mining engineers acquire eminence at an early age and as the presidents of the Institution are fortunately long-lived, the Council now contains 10 ex-presidents; if these and their successors live as long as we wish, the majority will eventually be composed of ex-officio councillors. Further, the election to the Council is a formality; the list of men nominated is prepared by the Council itself; only two or three are named besides those already serving, and those selected from the outside are usually friends of the dominating group, who themselves hold office without interruption. Another feature inviting criticism is the fact that several firms are represented by two partners. In consequence, the Council is too large; it is an amiable debating society unable to discuss a subject conclusively; therefore the important work is delegated to committees.

On the other hand, it is to be remembered that the members are largely resident abroad; the Council must be chosen from those who can attend the meetings, hence the group living in London must exercise control.

Moreover, it would seem a pity to lose the services—even for a year—of one or two men conspicuously identified with the work of the Institution; if one of these were to step down, he might be unwilling to step up again when, after a year, he became re-eligible for the Council. The Institution, of late years, has been served by a secretary of unquestioned competence and it has been represented by presidents of acknowledged worthiness. Numerically the membership is not yet proportioned to the large body of properly qualified men engaged in mining and metallurgy; before the Institution is accorded unquestioned right to speak for the profession its membership must be increased; and undoubtedly this increase will ensue if the rank and file of the profession is impressed with the representative character of the society. That impression can be strengthened by adopting methods to render the annual election something better than a recurrent formality.

Useful work has been done in stiffening the moral backbone of the profession, in standardizing technical terms, and in affording facilities for publishing contributions on matters of practical interest. Of these performances the first is much the most noteworthy; by itself it has amply justified the existence of the Institution. More work remains to be done, and it will be best done if the present members of council realize the weak points in their organization, avoiding dangers that are now obvious and striving toward ideals that are attainable.

Permitted to read the above, and invited to criticise it briefly, a member of Council writes: "The number of the Council and the many new names added in the last three years seems fair evidence of the absence of any desire to perpetuate a 'coterie.' In the past it has been recognized in principle that a member of Council who had for several years given freely of his time in the interest of the Institution might expect to become President; therefore changes, simply for change, did not seem desirable, so long as a reasonable introduction of fresh blood was kept in view. The choice of useful members is limited by their necessary residence in London. The late appointment of corresponding members of Council has led to an increase in the number of the Council by the election of London members to seats formerly reserved to non-resident members. It is doubtful whether all Past-Presidents should in future be ex-officio members of the Council, and it is a point now under consideration by the Council. It is advisable in the interest of continuity, and in order to retain as long as possible the services of good men, to have some past-presidents remain on the Council. Elections and ballots are not very satisfactory arrangements among a lot of professional men, having no real differences of opinions on policy, and all fully capable of being efficient members of Council; so that any limitation in number of past-presidents should be automatic, each retiring after so many years of service.

"The Council as now constituted seems to indicate less danger of a rule by "coterie" than in former years. In fact the deliberate effort of the Council itself to widen its base has led to the more serious danger of a cumbersome talking assembly incapable of efficient action owing to the multitudinous expressions of views. As this danger is recognized by all there will be perfect unanimity in facing and overcoming it. On the other hand it is highly probable that some men if once out of office would not consent to go in for a new competitive election; the prize is not great enough to justify the risk of the snub of defeat. Any widespread feeling against two members of a firm serving together on the Council, would require no great effort at combination to express itself effectively in the balloting papers."

We shall be glad to publish the views of others on this subject, which is one of general interest.

Cyanidation.

Our friend the editor of the *Mining and Scientific Press*, with that enthusiasm which marks the expression of American energy, has lately shown a disposition to refer the work of Rand metallurgists to American inspiration. To this, we are informed, some of our friends at Johannesburg politely demur. For example, they state that the practice of crushing in cyanide solution was first tried as long ago as 1893 in the May Consolidated mill, and the recent revival of the idea is credited to Messrs. W. W. Mein and W. K. Betty. Yet we hazard the guess that Mr. S. H. Pearce may have borne some fruitful ideas to the Rand from Mexico, where he made a close study of methods at El Oro. Ideas fortunately are infectious and it is not always easy to decide who is responsible for the intellectual stimulus that produces the metallurgical development. Another bone of contention is the rotary vacuum sand-filter, mentioned by our Johannesburg correspondent on another page. It appears that the editor at San Francisco hinted that it was a copy of Mr. Bertram Hunt's slime-filter, which is a totally different machine. Mr. W. A. Caldecott had a sand-filter treating sand at the rate of 200 tons per day fully two years ago at the Knight's Deep plant, before he himself made his recent *voyage metallurgique* to the United States. This moving vacuum sand-filter is, we believe, more akin to the device of Edward Parrish than that of Mr. Hunt. Apart from questions of priority, we learn that there is much activity in a metallurgical way at Johannesburg. Amalgamation away from the battery is being adopted and screens of 3 holes per linear inch are to be used for obtaining coarser crushing and higher stamp-duty. This product is suitable for the tube-mill, which is now firmly established. In this connection it is interesting to note that M. P. Boss's idea of stamp design is being developed by Mr. Caldecott, who has made promising tests with long-headed (48 inches) short-stemmed (13 ft. 6 in.) stamps working in an open-front mortar-box, which affords easy access to the heads and reduces the danger of cracks in the mortar-box. We hope to see the details in print before long and note with pleasure this further evidence of progressive development. At a mining centre like the Rand there is danger of a self-satisfied complacence hindering eager effort for betterment, and such a condition of lethargy did supervene for a time soon after the War, but, under the leadership of Mr. Caldecott, the technical men at Johannesburg appear now to be intensely alive to the necessity for a critical attitude in all matters pertaining to the economics of the industry.

Industrial Piracy.

Edward H. Harriman ceased to be a railroad magnate just as our last issue went to press, therefore we were unable to comment upon an event the significance of which lay chiefly in the manner in which the community received the news. The American public was already well acquainted with the facts of Harriman's life and was familiar with their bearing upon the development of the United States; but the British public, if we may judge from its spokesman, the daily newspaper, paid to the deceased financier the tribute due to a creator of beneficent enterprise. As viewed from a distance the man whose fatal illness had perturbed the stock markets of the world was described as the controller of 30,000 miles of railways, the director in companies owning 80,000 miles, the organizer of industry, the incarnation of American energy, and the magician of Wall Street. Testimony was also given regarding his worthiness as a family man and his amiability as a friend: but with these aspects of his personality we have nothing to do; his private life was his own, we judge him only by his public acts. From them we infer that he was an evil genius, the leader of the predatory promoters brought to the frothy surface of industrial development in America, an example of those malefactors of great wealth whose gigantic operations have confused finance with grand larceny, and corrupted the civic spirit of the American commonwealth.

We do not accept the sickly sentimentality of "*de mortuis, etc.*," holding that public men, whether living or dead, must be judged by their deeds, and that it is the duty of independent journalism to exact from a notorious career all the warnings that it affords.

Starting as a broker in Wall Street, he remained a stock-jobber always; it was only the scale of his operations that changed, from being stated in hundreds to being measured in millions of dollars. Early equipped for the chicanery of railroad manipulation, he soon proved himself a force with which the other pirates of finance had to make terms. Evading the law, he achieved big consolidations. Defeating legislative precautions, he established a gigantic monopoly. He was not always destructive, because profits were to be made by improving railroads as well as by wrecking them; he diverted to himself and to his friends $23,000,000 from the Chicago & Alton, but he improved and reorganized the Union Pacific so that it paid 10 per cent. In order to control the legislature of California he debauched the politics of the State; he so corrupted the business of the Pacific Coast and the municipal life of the principal cities, that both San Francisco and Los Angeles to-day reek to heaven. He and his henchmen established a tyranny more debasing than a military despotism. His motto, like Vanderbilt's, was "the public be damned;" his policy was to levy "all that the traffic will bear." It is true that he improved some of the transcontinental railroads, to make them more effective as counters in the big gambles of the stock market; under his guidance the railway officials became speculators, and the map of the United States became the record of his contest with rivals; the destinies of isolated communities became the sport of reckless gamesters whom a subservient Press labelled "railroad kings" and "financial magnates." Harriman was anti-social; he emphasizes that drift in American development whereby men, clever and unscrupulous, can amass fortunes and win power by practices that are immoral even if legal, by financial legerdemain that ridicules honesty, by gambling so colossal as to provoke national disaster, and by corruption so powerful as to entail national disgrace.

Anglo-American Enterprise.

Many important mines in America are operated by British corporations, and it is satisfactory to note that several of them are highly profitable undertakings. These mines were 'floated' by the combined efforts of American and English promoters, and in several cases the American stockholders included not only vendors but other speculators living on the western side of the Atlantic. In one or two instances, such as the Tomboy and the Dolores, the transfers of stock have led to a shifting of control from a British to an American majority, or the reverse, with a consequent change of incorporation. The latest example of this kind is the Oroville Dredging, Ltd., an American corporation, which now becomes the Oroville Dredging Co., Ltd., a British corporation. The transfer of control has not been effected without friction, and the incident affords text for a few friendly remarks. It is always easy to start a warm discussion among mining men by asking the question as to whether British or American management of companies is the more beneficial to shareholders, for there are many that have tried both systems of control. Being without prejudice, we say at once that the chief defect in American management is disregard of minority shareholders, while the main failing of British management is its expense. The useful discipline of Companies Acts is unknown in America, and neither law nor custom enjoin upon directors such responsibilities to minority shareholders as are recognised, both by law and custom, in London. The minority shareholder in America is a negligible quantity. Sometimes, it is true, the welfare of the majority coincides with that of the minority, but the coincidence is only a fortuitous circumstance, originating from chance, not design. Hence an Anglo-American company controlled in America is apt to exhibit a disregard for the usual amenities between directors and shareholders, especially in the transmittal of news from the mine and the prompt issuance of reports. Thus under the regime of the American board the Oroville Dredging stockholders now receive the fiscal report for the year ending June 30, 1908, when they ought to have the report for a whole year later. The gold extracted by dredging is promptly marketed, so that there is none of the excuse for delays reasonably allowed to smelting companies or other enterprises having products that require time for realization. Now that control has been transferred from New York to London we shall expect recognition of the rights of shareholders, and we believe that it will be accorded cheerfully. Turning to the American view of British management, we are compelled to recognize the complaint of extravagance at headquarters. The English companies spend more money for consulting engineers; this is natural because the English owners are farther from their property than the Americans, and they deem it worth while to be thus safeguarded. They also spend more in office expenses; this is entailed by the greater elaboration of system, but, in our opinion, the extra cost is a tax that the shareholder can well afford to pay, since it yields him better access to information concerning his property. One fundamental error the London director dare not commit under pain of personal legal responsibility, and that is the acceptance of a vendor's report in establishing value. In the case of Oroville Dredging, we have an illustration of what may be done in the United States: Mr. W. P. Hammon was one of the owners of the Oroville properties; he was one of the engineers to pass upon them, and he was appointed general manager. Thus he became triply a sponsor for the enterprise. To prevent misunderstanding it should be explained also that Mr. Hammon did not receive money, but shares, from the company formed to acquire the group of claims, yet as a participator in the transfer his judgment may have been prejudiced by the fact of ownership. Much of the ground transferred by him to the consolidation has proved disappointing. We understand that Mr. Hammon is not a vendor in the Colombia business and we know that this new property was examined by Mr. C. H. Munro, one of the most reliable of dredging experts. We are fully aware of Mr. Hammon's high reputation as a successful dredge operator, and we know that his local manager, Mr. Newton Cleaveland, is a man whose services any dredging company would be glad to retain. Thus our criticism will not be misunderstood; we find fault not with any man, but with an unbusiness-like procedure. Vendors and promoters should not report on mines; it is as honourable to be a promoter as to be an engineer, but the combination is prejudicial to sound business.

Johnson as a Journalist.

Lord Rosebery on Johnson is more convincing than Lord Rosebery on the Budget; in the one case we have the scholar and the philosopher, in the other the landowner and the politician; and yet it is all to the honour of English public life that capacities so diverse are combined in the characters of our statesmen. Lord Rosebery chooses to plough the lonely furrow and apparently he loves to stand in contemplative pose on some carefully chosen elevation, but the scholar in him compels a communion of ideas that makes the ex-Premier a friend to thousands wherever the English language is spoken.

This is the year of the Johnson bicentenary; to the geologist two hundred years is nothing, to the social reformer it is a geological period; but there is one incident in Johnson's life that proves how wide an interval disjoins our day from his: it is recorded that to be cured of disease he received the touch of Queen Anne's hand, expecting a miraculous cure. And yet he was a hard-headed man, one of the most virile intellects our country has produced, a big heart and a noble spirit, a king of men. In his address Lord Rosebery touched upon a feature that brings Dr. Johnson's character within the scope of the comment even of the editor of a technical periodical. In his eloge the ex-Premier exclaimed: "What a journalist he would have made!" Nay, what a great journalist he was; for surely the versatile commentator and social philosopher who wrote regularly for *The Gentleman's Magazine*, *The Rambler*, *The Idler*, and *The Adventurer* was a journalist, unless the term is to be confined to those who work on the daily Press. In Johnson's day the daily newspaper did not exist. He re-lit the torch handed down from Addison and Steele, publishing critical essays and profound observations upon human life in the periodical literature of his day; and he did it with a profundity of thought and a labour of language that are overwhelming. And in the intervals he prepared prefaces and wrote dedications for other authors, not to mention the compilation of a dictionary. Nowadays dictionaries are prepared by a carefully organized army of specialists, but Johnson gave us the first great dictionary off his own bat. As Boswell says: "He conferred stability on the language of his country." Indeed he was a journalist, of the special variety that obliterates the line between journalism and literature. He could tear the heart out of a book, assimilating all that was best in it; his memory, his range of reading, his ripe composition were, as Lord Rosebery has emphasized, instantly at his command so as to enable him to write or say something notable on almost any subject. He saw one aspect of a question at any one time and illuminated it; he possessed astonishing versatility united to robust common-sense; can we imagine a better equipment for the hurly-burly of journalism? His sturdy independence of thought was a characteristic unusual in a sycophantic age, and it is not too much to say that his letter to Lord Chesterfield declining the patronage of a false friend will live in literature long after that nobleman's 'Letters to his Son' are forgotten.

He had a firm grasp on realities. It is

the function of journalism to hold the mirror to life, reflecting current ideas as best it may. Johnson performed this function for his day and generation with a superb insolence; he did not tread gingerly nor did he speak in whispers; having had his say he left it to others to make the inuendoes. Of course, he ruffled some sensibilities and he flouted many pretensions, thereby admitting the clear light of intelligence upon the affairs of the community. He was rough but kind, belligerent but generous; he was built on a scale of twelve inches to the foot. What if he did demonstrate that one cannot make an omelet without breaking eggs, was not the dish *aux fines herbes?* Think of Johnson in the chair of Delane! Imagine the John Bull of literature fulminating and coruscating as in those sessions long ago at the Mitre. Would not life be worth living?

Protection of Investors.

On another page we publish the set of resolutions finally adopted by the Mining and Metallurgical Society of America after a careful discussion before meetings held at New York, Philadelphia, and San Francisco. The resolutions are worthy of careful perusal, for they were framed by men of sincere purpose and wide experience. For the sake of our English readers we may state that the society that has taken this action in the public interest is of recent origin, and was organized for the particular purpose of crystallizing the better sentiment of the mining profession, with a view to improving the ethics of the mining business. The membership is small because it is restricted to men of approved worth, but what it lacks in numbers it makes up in force. Assuredly there is scope for an institution dedicated to the good work of lifting mining affairs from the swamps of chicanery to the high places of moral endeavour. It is such work as the Institution of Mining and Metallurgy is trying, not without success, to accomplish in London. We expect no millenium either to-morrow or next year, but at least we may hope to see mining adventure recognized, not as a wild gamble, but a sane speculation, neither without risk nor without responsibility, but with chances as good for the making of money honestly as any other branch of human activity. To promote this result it is necessary that directors act as trustees, not as privileged speculators; and that managers serve the whole body of shareholders, not a clique. If speculators refuse to play the game with those who break the rules when it suits them and will consistently support those who observe the unwritten laws of honest men, we may hope to see a constant betterment. The decision is in the hands of the public, more particularly that intelligent portion of it which does not speculate blindly, but with eyes fully open to all the inevitable dangers of this form of adventure. The dangers are inseparable from the profits, the winnings are proportioned to the risks, and by insistence upon an observance of the rules of the game the speculator, like the gambler, can see to it that at least there are no loaded dice, no cards from the bottom of the pack, no interfering pins on the roulette table, and no dealer with a shot-gun to enforce an attempted iniquity.

Resolutions by societies and editorial endorsements of them may not succeed in compelling those in control of mining companies either to give adequate information to their shareholders or to forbear from otherwise abusing their trust, but at least a healthy public opinion can be created; we can crystallize sentiment, and thus induce conditions favourable to right dealing; we can make it easier to be honourable and more difficult to do wrong.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Underground Drill - sharpening. — A short time ago the management of the Crown Mines experienced some difficulty with their men in the introduction of underground drill-sharpening. This practice, involving the use of oil-furnaces, is gradually growing in favour and importance. The saving made by avoiding the hoisting to surface of the thousands of hand and machine drills in daily use is the chief advantage sought. There are now about a dozen sharpening - stations underground. Until the ventilation and lighting arrangements are properly regulated, these stations are less agreeable than the surface 'shop,' and as there is no surfeit of competent sharpeners, the highly skilled men naturally seek work on contract or day's pay where the conditions are more favourable. In the course of time drill-sharpening underground will be undertaken in the deep levels almost as a matter of course. The men are receiving 22s. 6d. per shift, as compared with 20s. on the surface, and work shorter hours, so there appears to be small reason for dissatisfaction. Electric drill - sharpening has been tried on the Rand, but does not gain in popularity. The agents claim that the mines have not given it a fair test. I can only record the fact that it is not being practiced anywhere on the Rand to-day.

Premier Diamond Mine, near Pretoria
(The general manager W. McHardy is in the foregronnd).

Rose Deep—Glen Deep Amalgamation.—The latest 'fusion,' as it is termed, is that of the two Rand Mines subsidiaries, the Rose Deep and the Glen Deep. These adjoining properties have long been in the public eye as lending themselves readily to consolidation. As the new Rose Deep will hold only 305 unexhausted claims, it will clearly be less important than other recent amalgamations, such as the East Rand Proprietary, City Deep, Crown Mines and Randfontein South. Although it will not assist in the development of any deep level ground, otherwise more difficult to exploit, the scheme should not be without strong support on engineering principles.

Sand-Filter Tables.—As there still seems to prevail considerable misconception as to the functions of the rotary filter-tables erected at the Simmer Deep, the paper read by their inventor, W. A. Caldecott, at the last meeting of the Chemical, Metallurgical and Mining Society came at an opportune time. The tables are essentially designed to replace collecting vats, and to give a good leaching sand-product. Nearly all the slime has been removed by conical classifiers before the tailing reaches the tables through which the water and remaining slime is driven off by vacuum. The moist sand is scraped off the flowing revolving table by means of a stationary plough and falls into a launder, fed with a 0·03% KCy solution. The chief claims for the plant are the big saving in capital expenditure, as compared with the ordinary collecting-vat system, the greater rapidity of gold solution, the low costs, and the slightly reduced value of residues. One of the highest tributes yet paid to the new scheme of sand-filtration has come from J. R. Williams, the former chief metallurgist of Eckstein & Co., who declared that the simplicity and efficiency of operation of the plant aroused the wish that he could be a cyanide manager again.

Van Ryn Deep.—The assays from the west shaft of the Van Ryn Deep, which cut the lode at the end of August, are disappointing. The average is announced as 5·1 dwt. over 25 inches. There is a lot of talk about the possibilities of the leaders 24 ft. above and the intervening quartzite, just because these are all worked in some stopes in the Van Ryn, where the Main Reef and leaders are within a few feet and of high value. Instead of entertaining these shadowy hopes of making a 5·1 dwt. lode look well by adding 20 ft. of quartzite and a doubtful leader to it, shareholders would be wiser in recognizing that the particular place cut by the shaft is poor, just as a hundred such places are poor in the most prosperous East Rand mines, and that judging by the far more reliable evidence of possibilities provided by neighbouring properties, the New Kleinfontein, Van Ryn, New Modderfontein and Brakpan, the chances are in favour of a mill grade of from 26s. to 30s. per ton. No sounder estimate than this could be made, whatever the value of the shaft disclosures. But then the market does dearly love the assays of a new strike.

Government Statistics. — Time was when the monthly statistics issued by the Transvaal Mines Department were eagerly devoured by the partisans of divers labour policies and, when almost every detail in the industrial records, from coal output to the accident rate, was twisted into evidence in support of some contention. The statistics are still compiled with wonted accuracy and thoroughness, but it is doubtful if they continue to be of much popular interest or, save in certain features, of technical value. The monthly gold output, with the increase or decrease, is about as much as the 'man in the street' (invariably a 'mining expert' in Johannesburg) can manage mentally to absorb in the way of statistics, and this is announced by the Chamber of Mines ten days before the Government declaration. The Mines Department's returns contain information, however, that is not available from other sources. From the records for July, the following points are culled as typical of the data obtained from mining companies and illustrative of the mining industry's position: Transvaal mines with active mills 115, of which 70 were on the Rand. Stamps dropping, 9811; and 142 tube-mills. Rand output, 1,796,371 tons, yielding £1,637,177 from plates and £898,032 by cyanidation. The Transvaal's productive mines did 75,508 ft. of development and the non-productive 18,125 ft., making altogether 18 miles in drifts, cross-cuts, winzes, raises, and shafts during the month. There were 2655 rock drills at work and 2,437,800 lb. explosives were issued to gold mines. The labour employed on the Rand totalled 21,115 whites, 160,371 coloured men, and 5360 Chinese; and on all Transvaal mines, 23,755 whites, 192,718 coloured men, and 5360 Chinese. There were 157 separate mining accidents, resulting in the death of 79 men. The production of coal amounted to 317,802 tons worth at pit's mouth—5s. 1·3d. per ton. The yield of tin ore was 167 tons, valued at £13,875; of copper ore, 138 tons, valued at £4271; and of galena, 224 tons, worth £2034.

Stope-Drill Records.—Undoubtedly some remarkably speedy drilling is being done by certain machines competing in the stope-drill trial. We await with interest a full official record of the competition. On August 20, the Chersen 2¾-in. machine drilled 118 ft. in a shift; a week later, the Holman 2⅛-in. drill beat this record with a total of 122 ft. 5 in., putting in 28 holes. Such standards of efficiency in 'banket' are highly encouraging, even though it is hard to determine how much of the credit is due to the skill of the operator and how much to the mechanical qualities of the drill.

Transvaal Tin.—The public is truly hard to please. For several years the cry has been that the geological and mining experts of the Government departments have paid inadequate attention to the economic aspects of outside mining, that the geologists have been too scientific, and the mining engineers too statistical. Now, thoroughly comprehensive reports are being issued on the tin districts and because the positive conclusion is not as wildly optimistic as some shareholders would like to see, the policy of issuing such critical descriptions of the workings and prospects of 'struggling' enterprises is widely censured. Whatever the impressions of the speculator, the report of U. P. Swinburne, of the Mines Department, is a valuable production. The properties in the Waterberg tin district are divided into five classes, namely, occurrences of tin in (1) granite, (2) felsite, (3) shale, (4) quartzite, and (5) alluvial. The most important deposits are those in the granite, including Zaaiplaats, Groenfontein, and Solomon's Temple. In the quartzite occur the well known mines of the Weynek and Rooiberg Mineral Co. Mr. Swinburne's opinion is expressed in too guarded a fashion to be dangerously encouraging.

Alluvial Gold.—It is reported, with a semblance of authority, that Mr. Watson, the well-known labour leader of Queensland and ex-Premier, has decided to start a dredging venture on the Thabina river in the northern Transvaal, which has not appealed to former investigators. It is refreshing, indeed, to find the Australian journalistic leaders forsaking their democratic land of free prospecting and open-door policies to seek investments in the "magnate ruled" and "capital cursed" country, in which private ownership and vested interests are held to stand prominent on the national shrine.

Costs and Profits.—Total monthly profits on the Witwatersrand have remained constant throughout the current year, as shown below: Comparing July with January, it is to be seen that the yield is down 1s. 7d., the cost is lower by 7d., and the profit 1s. per ton milled. Up to the end of July, the Transvaal gold output was £18,084,512, as against £16,924,697 for the corresponding period in 1908. The year's yield promises to be between £31,000,000 and £32,000,000.

Glynn's Lydenburg, Transvaal.
(This district is now attracting attention.)

	Tons milled.	Yield per ton.	Working cost.	Working profit.	Total profit.
January ...	1,671,245	29s. 8d.	17s. 5d.	12s. 3d.	£1,021,881
February ...	1,539,270	29s. 10d.	17s. 9d.	12s. 2d.	935,846
March ...	1,719,758	28s. 10d.	17s. 4d.	11s. 5d.	981,836
April ...	1,693,234	29s. 0d.	17s. 2d.	11s. 10d.	997,062
May ...	1,765,048	28s. 7d.	17s. 0d.	11s. 7d.	1,016,862
June ...	1,716,192	28s. 9d.	17s. 2d.	11s. 7d.	1,013,773
July ...	1,785,450	28s. 1d.	16s. 10d.	11s. 3d.	1,000,118

Nigel.—The most profitable gold mine outside the Rand is the Nigel, which is one of those prosperous concerns, including the Salisbury, Jubilee, New Heriot, and City & Suburban, financed by Natal investors in the early days. To-day the Nigel stands almost isolated on the southern rim of the Rand basin (outside the Witwatersrand area), but in years to come this outlying district will be linked with the East Rand mines. The Nigel is making a steady £7000 per month. Its costs have been reduced from 43s. 2d. per ton in 1904, when the expensive practice of 'resueing' was largely adopted, to 20s. 2d. in 1909. Since its inception the company has paid out 352% in dividends, equivalent to £680,000. The most unfortunate fact about the Nigel is its loneliness as a prosperous mine. The Nigel Deep has always been disappointing, and other companies to the east and south have made no headway.

MEXICO.

The disastrous floods in northeastern Mexico have been so serious as to evoke world wide sympathy. Monterrey, the capital of the State of Nuevo Leon, suffered most severely; it is a city of about 60,000 inhabitants, and is situated at the embouchure of a torrential river, just where it issues from the mountains. The river is known as the Santa Catarina, and a large portion of the city inhabited by the poorer classes was built on the low-lying banks of this river. The waters rose so rapidly during the first night of the flood that the escape of thousands of persons was cut off; these took refuge on the top of the flat-roofed houses, hundreds of which were undermined and were washed away. The total loss of life is unknown, but over 1200 bodies have been recovered, and the estimate made by the authorities places the loss of life in the Monterrey district at over 3000, and the property loss at 20,000,000 pesos.

The total rainfall during the 72 hours of the storm that caused the flood was approximately 22 inches. Owing to the high mountains back of Monterrey, and the fact that the Santa Catarina river drains an area of 1000 square miles, the concentrated volume and velocity of the water in the gorge issuing from the mountains was enormous. Estimates and measurements made by engineers place the velocity of the water in the centre of the stream at 30 miles per hour and the volume at 200,000 litres per second, which is one half the flow of the Nile and one fourth the flow of the Mississipi, when these rivers are in flood.

The plant of the American Smelting & Refining Co. which is located at Monterrey was uninjured, but the Monterrey Smelting & Refining Co.'s plant was badly damaged. The steel plant, which is the only one of importance in Mexico, suffered severely. The railroad lines have been crippled by landslides and wash-outs, destroying bridges and culverts, as well as track, but splendid work is being done by the engineering staffs, and relief trains were rushed into Monterrey within a few days of the disaster. The American residents and other foreigners in Mexico have responded generously to the call for help, and the railroads are carrying all relief supplies free of charge.

Confidence.—July and August were unfortunate months for Mexico, first the terrible earthquakes at Acapulco, then a great fire in the business portion of Monterrey followed by the flood, and added to this, there was the political unrest, which while not showing any violent symptoms, and none that the Government was not well able to control, was still sufficient to cause uneasiness in financial circles. It is worthy of note that through it all financiers who are thoroughly acquainted with Mexican conditions and temperament by personal residence in the Republic, have not hesitated to show their confidence by further investments in the country. The American ambassador, David E. Thompson, has been negotiating for the purchase of the Pan-American railroad, and although the sale is not a foregone conclusion, the prospects look promising; it would mean much for the development of the South, as the existing company has never been able to raise enough capital to do more than start this ambitious project.

Greene properties.—The sun of the great promoter, W. C. Greene, is fast setting, and the various Greene ventures are one by one passing into other hands: The Sierra Madre & Pacific railroad was taken over some time ago by Dr. F. S. Pearson and associates, and during the month of August the properties of the Sierra Madre Land & Lumber Co. were sold at auction at Chihuahua to liquidate the bonds of the company; these also were bought by Dr. Pearson for $2,000,000. The immense exploration rights held by the Greene interests in northern Mexico lapsed some time ago, and the following mines and mining companies formerly controlled by Greene have now been taken over by the Cole-Cotten combination: The old Balvanera, the Belen, Santa Eduviges, San Ramon, El Refugio, and various other minor prospects. Thos. F.

Cole is head of the Greene-Cananea Copper Co. and with his associates, Jos. B. Cotten and Richard M. Atwater, have incorporated the Sierra Consolidated Mining Co. under the laws of Arizona with a capital of $5,000,000, for the purpose of developing the above properties.

Pearson.—If the Greene holdings have decreased in importance, Dr. Pearson and associates have made up for it by buying and consolidating various large properties, including over 3,000,000 acres of timber land and several small railroads in Chihuahua. One of the last purchases was the Rio Grande Sierra Madre & Pacific railroad, which includes a Federal concession giving the rights to build a railroad to the Pacific Coast, and Pearson's engineers are looking into the possibility of running a line through the Sierra Madre to connect with the Southern Pacific at or near Tonichic in the Yaqui valley, in Sonora. It is also rumoured that an extension of the existing Rio Grande, Sierra Madre & Pacific railroad will be run south to connect with the Chihuahua Pacific and Sierra Madre, probably near Santo Tomas, This last line is also controlled by Pearson; it has a length of about 180 miles and runs westward to Temaschic. Dr. Pearson must not be confused with Sir Weetman Pearson, of S. Pearson & Sons, London.

DENVER.

Waiting is the keynote of the mining situation in Colorado. It is not, however, the attitude of a Micawber, but rather the pose of the miner who has drilled his round, placed his shots, and is now wondering what the blast will uncover. The air is electric with impending changes, but meanwhile things are as quiet as in the hush before a storm. At Cripple Creek the big producers have practically all stopped pumping and development, and are grubbing around in upper workings until the Roosevelt adit shall be completed and drain the ground. The 'tunnel' is making excellent progress. Since June, when the portal workings were connected with those on the intermediate shaft, there has been but one heading to push. A. E. Carlton, the contractor, has three shifts of men at work, and 410 ft. was accomplished in August. At this rate the tunnel should begin to drain the mines in about 15 months. It is expected that shortly after there will be a heavy production from the lower levels and that Cripple Creek will experience a new boom. In the meantime the tonnage going out is not small, though the grade is low. In August 65,330 tons having a gross value of $1,346,814 was shipped. It is significant, however, that only 4350 tons was of sufficient high grade to go to the smelter and that the largest tonnage, 24,180, went to the Golden Cycle, a cyanide mill. Both smelters and chlorination mills have been dropping behind in the race for tonnage, in accordance with the rule that as the grade of ore drops the cheaper but less efficient processes become economical. The beginning of a further step is seen in the introduction, by Philip Argall, of concentration into the mill of Stratton's Independence, for treating low-grade and dump ores. It is found that 30% of the gold in these ores can be so saved. By supplementing cyanidation a total saving of 65% is effected. The low value of the ore makes it unprofitable to attempt a closer saving.

Rich Pockets. — There are many reminders of old conditions at Cripple Creek. Rich pockets of surface ore are still found. Near the Moose, some lessees in June sunk a windlass-shaft and at 18 ft. went into ore. They have since shipped approximately $10,000 worth with no machinery and little expense. Not far from the Nightingale, as this lease is called, the Cresson Consolidated, a close corporation of Chicago men, has a mine from which last year 32,000 tons averaging $20 was shipped, and as the mine is worked with filled stopes, only a small portion of the ore developed went out. The cost of mining here is low since the shaft is less than 1000 ft. deep, the equipment simple, and the ground nearly dry. Ore containing 5 oz. gold per ton is now being shipped. The property, by the way, is one of the few that delivers ore by means of an aerial tram. These are beginning to be built in this district, which has previously depended entirely on wagon and rail for transportation.

At Leadville, interest centres on zinc. This long despised mineral is now of large local importance. Zinc ore, next to the lead carbonate ores which still maintain their dominant position, furnishes the largest part of the local output. It is true that, like confederate money in 1865, it takes a lot to buy a pair of boots, but still the zinc output keeps the mines and mills going. Wonders in treatment have been realized. Last year the American Zinc Extraction Co., operating a magnetic concentrating mill at the mouth of the Yak tunnel, handled 40,000 tons of ore from the Iron-Silver mines that carried only 13% zinc, and the Empire Zinc Co. has shipped a considerable tonnage that ran only 15%. Since these ores have little value except for the zinc, the silver going with the lead, the results quoted speak well for present technical practice.

Smelting conditions in Colorado are undoubtedly bad. It is an open secret that aside from the Durango plant, whose prosperous career is now marred by floods that have wrecked the railways and cut-off ore supplies, the Colorado plants have been short of ore for months. The famous old Argo has only run 2 of its 5 furnaces for some time. Recently one of these was put out of commission and now it is announced that the plant is to be dismantled and the company liquidated. This is not due to any technical or financial failure of the company but an expression of changed conditions. Colorado does not now produce as much ore of smelting grade as formerly and ores mined in other States are smelted nearer home. The Globe smelter at Denver is running mainly on lead ore from the Coeur d'Alene and silicious ore from Cobalt. The Leadville smelter is not working to capacity and everywhere the mills are taking the business. Even in Gilpin county a 300-ton cyanide mill is being erected to treat ore direct from the mines. It has long been thought that Gilpin ores could not be treated by cyanidation, but Percy Alsdorf and Marshall Draper bave refused to be scared and after a year of experimental work in the mill of the Fifty Gold Mines Corporation, feel sufficiently sure of results to go ahead. No new process is claimed; it is merely that the fresh ores, containing quartz, pyrite, chalcopyrite, and gold, are amenable to the treatment. The sulphates in the oxidised ores, on which previous experiments have been made, increased cyanide consumption to an unprofitable figure. At Georgetown the Western Metals Co. has broken ground for a 300-ton mill to treat ores by the Malm dry chlorination process. This, originating in Germany, has been applied at Corwin, Montana, to complex sulphide ores. The mills are not, however, to have it all their own way; H. A. Riedel has organized the North American Mines Smelter Co., and taken over the old Carpenter pyritic plant at Golden. The furnaces are being overhauled and at the same time a vigorous campaign of development is being waged in the affiliated Rockford tunnel near Empire. While it is expected that most of the ore to supply the furnace will come from properties owned by the company, the Kilton sampler at Idaho Springs has been purchased and ore will be bought whenever possible. Another competitor is the Modern Smelting Co., which is just completing a plant near Utah Junction, north of Denver. The plant is designed to treat copper ores by semi-pyritic smelting. It is financed by Chicago and New Orleans capitalists and is a well-designed and well-built plant, able to operate with every economy. Whether the company will succeed in getting sufficient ore to run steadily is open to question. The Gilpin ores, which furnished the incentive for building the original Argo plant, are now neither so abundant nor so rich in copper, and the new company will evidently have trouble in securing a steady and suitable supply. A not unimportant factor in considering the future output of Clear Creek and Gilpin counties is the Newhouse tunnel. This, after many vicissitudes, is nearing completion; the breast is now well over toward Nevadaville. Under the management of George Collins the tunnel is not only being driven rapidly but is now producing a revenue.

In the San Juan matters are quiet, although the big producers have been working steadily and particularly good reports come from the Camp Bird. The recent flood took out the railways and some of the electric lines. For a while Telluride was in darkness and even now gets mail by stage. It is estimated that it will be six weeks before the railway can be rebuilt to Telluride, but communication between Durango and Silverton will be restored much sooner.

Discoveries continue to be reported from various parts of the state. The rich ore in Routt county proves to have originated in the imagination of a drunken miner. More substantial is the report of the discovery of $30 ore in the Archean rocks near Newcastle. This orebody, if it prove large, is of importance in extending greatly the known limits of the mineralized territory of the State. At Salida $100 ore has been found and a small stampede occurred early in August. Not much information is available and the property is being guarded by armed men. Since, however, the area is known to be mineralized and both sedimentary and igneous rocks are present, some hope of a real discovery seems warranted. In the meantime scouts are out in various directions and Colorado is waiting for changes in the old camps, but most of all and with deepest longing for the discovery of the new camp that has so far never failed to follow a period of hard times with its concomitant searching of souls and of hills.

The fact stands out that there has been a falling off in the output all along the line. Apparently the eastern States, as gold producers, have passed their prime. Victoria lately has made some recovery but the results will be ephemeral unless some of the neglected "deep leads" can be made productive. The Legislature is doing its best to hamper dredging operations because a portion of the community insists that the streams shall be preserved for agricultural service. In the Ballarat district the famous

Scene of gold discovery in Colorado.
The mine is seen near the right edge of the photograph. On upper left the Archean rocks appear under the coal measures.

MELBOURNE.

Gold Mining in Australia at the present time is depressed, especially in the older States, where work has been continuous for the last 50 years. The returns for the first half of this year compare with those for the corresponding terms in 1907 and 1908 as follows:

	1907. Oz.	1908. Oz.	1909. Oz.
Victoria ...	352,664	329,434	321,705
New South Wales...	138,489	112,063	90,067
Queensland ...	227,077	214,861	204,191
West Australia	838,256	827,016	782,067
South Australia	8,774	4,414	1,800
Tasmania ...	33,000	33,000	30,000
Total... ...	1,598,260	1,520,788	1,429,830
New Zealand	212,928	237,169	223,016
	1,811,188	1,757,957	1,652,846

Berry lead has shrunk into a small producer, the failure of the companies promoted by Bewick, Moreing & Co. to open up profitable ground in the lower reaches having proved disastrous to deep-lead mining. It is not established that gold does not exist in payable quantities low in the gutter, as only one of the companies ever got into the lead, but where the mistake was made was in not testing the wash at a point near existing mines instead of far away into unknown ground. However, at the Berry United such a test is being made, but results there are not cheerful; what should be payable ground is taken out without any profit.

Quartz Mining. — Ballarat is most depressed. The fact is being established that in depth the gold contents decrease. The best example is the Star of the East where at about 3000 ft. the lode exists but contains only a trace of gold. The best ore was got where the lode is flat. As soon as the dip increased the gold contents began to diminish. At Ballarat East some of the 'indicator' mines have hit upon marvellously rich patches but these are not persistent, and the companies have had to depend for dividends on the large low-grade formations. At Bendigo there has been somewhat of a revival but it has occurred through the companies coming up nearer to the surface to work formations formerly neglected.

New South Wales exhibits a dwindling yield of gold, owing to the reduced output from the dredges, and the lower grade of the ore mined. In Queensland the decline is due to the same causes as in Victoria. Increasing depth has brought its penalty to Gympie, Croydon, and Charters Towers, although in the last of these districts some recent developments appear to promise an increased return from properties that have been plugging away with dead work. These references to the old districts illustrate the reason for their declining yield; the actual fact is not publicly stated. In Western Australia the same condition rules, to a modified extent. There the modern engineer does not believe in letting valuable ore remain in the ground; he works on a scale practically unknown on the eastern slope save in copper or lead mines, and so shortens the life of mines more rapidly than in the older States. That Kalgoorlie mining is on the down grade may be denied, but the truth has to be faced. Lower-grade ore necessitates handling larger tonnages to maintain the output. The Great Boulder is the deepest mine in the district and it is an open secret that the bottom level is disappointing despite the improvement in the level above. All this is to be expected because worldwide experience proves that gold veins become impoverished in depth. But this fact does not mean that gold mining in Australia is done. The country is so vast and exploration so incomplete that there is always the hope of a new district, to be discovered by the intrepid prospectors who are making their way into the arid regions of the Continent.

Recent Discoveries.—The latest news of a find is from a spot about 350 miles south of the north coast line and on the boundary of West Australia and South Australia. Rich ore is alleged to have been got there. Already men from all parts of Australia are starting thither. Tanami, as the find is called, is a dreadful spot to reach. Waterless and on the fringe of the tropics, only gold could allure men thither. To the south a stage of 230 miles has to be done without a drop of water; to the west and north the distance to water is about 60 miles. All supplies have to be packed on horseback and probably would cost at least £100 per ton when transported from the nearest seaport on the Cambridge Gulf in northwest Australia. Who will deny that the Australian prospector does not deserve his reward?

Lead and Copper.—These industries suffer from the low price of the metals. The attitude assumed by the labour leaders in respect to increasing wages at Broken Hill and the lack of support from other companies caused the Proprietary Company to close-down its big mine. Nearly 2000 men have been thus thrown out of work because of a difference of 7½d. per shift in wages. The common rule made by the High Court lasts until the end of the year; there is not the least chance of the company re-opening its mine unless the men agree to come to terms—which is not at all likely because the other mines have already acquiesced to the labour demands. So the Proprietary Company will be left with two strings to its bow, namely, custom lead smelting and zinc concentration. In respect of the first, the Proprietary has joined the lead convention, but the other mines have not done so. It is understood that some of the Rhine smelters stand out of the general agreement until the North and South Broken Hill Companies come into the fold. The North has placed its output for the next five years at a returning charge of 89s. with an allowance of 1¼% lead for the difference between the wet and the fire-assay. This is a much lower charge than the Broken Hill Proprietary has demanded and is much less than has ruled here for some time past. It is questioned whether the reduction portends the break-up of the 'combine' among German ore-buyers and the possibility that lead may again increase in price. The mines at Broken Hill that are doing best now are the South, North, and the South Blocks.

Copper Mining.—Mount Lyell has not got any body of ore yet at the bottom level (1100 ft.), though the 1000 ft. level has opened up splendidly. On the other hand the company has developed the industrial side of its enterprise into a splendid business and has acquired a new deposit of iron sulphides near Zeehan. It has a party of prospectors out in the wilds of Tasmania investigating some copper deposits at Mount Balfour. The ore is in a silicious matrix and the most that can be said about it is that grand prospects have been obtained. Mount Morgan now is practically more a copper mine than a gold mine and its promise is splendid, for it will be linked up with the Many Peaks pyritic deposits carrying about 2% copper. Thus a payable flux will be available and costs will slide down and the copper output increase. The decline in the gold yield from the oxidised ore is shown by the fact that whereas in 1901–2 117,021 tons gave 61,973 oz., in 1908–9 the figures were 108,191 tons for 17,236 oz., the average dropping from $10\frac{1}{2}$ dwt. to 3·19 dwt. per ton. With the sulphide gold ore the gold contents are now 9 dwt. against 14 dwt. in 1901–2. The company's reserves on May 31 last were 1,368,000 tons containing $3\frac{1}{4}$% copper and 8 dwt. gold, and 1,824,600 tons carrying above 3% copper and $2\frac{1}{2}$ dwt. gold. At the Many Peaks mine already 840,000 tons of ore have been proved. Affairs at Chillagoe are quiet pending the extension of the company's railway to the Etheridge field and the resumption of operations at Mungana. At Cloncurry also extension of the railway to the Hampden and Elliott mines is awaited. About 1000 tons of blister copper have been made at the Mount Elliott in its preliminary campaign. Now the smelter will be shut-down until the end of the wet season, when it is hoped that the railway will reach the district.

Great Fitzroy.—A second Mount Lyell mine appears on the horizon. This is the Great Fitzroy mine in Queensland. It is an interesting fact that the backer of the property, until Bewick, Moreing & Co. came along, was Philip Charley, one of the original owners of the Broken Hill Proprietary mine. He holds over 250,000 shares in the Fitzroy now. He is a man of wealth apart from the Fitzroy, he can well afford to sit down on his holding. In May 1907, the first purchase of 25,000 shares was made at £1 per share. Four months was given to develop the mine, with an option to buy 25,000 shares more for £25,000, and in this purchase a bonus of 50,000 shares was included. The property was taken over by the present company in July 1908, the working capital subscribed being £37,500, with a total issue of 375,000 shares of £1 each. A block of the unissued scrip was sold at 20s. per share recently and a call at the same price was given over 100,000 shares at £1 each. Looking at the business in a cold-blooded way it seems to have been the worst of business tactics for the directors to have given this option. The mine at the time was paying its way, 900,000 tons of ore had been proved, and the value of the property was established beyond question. But the majority of the shares in the company are represented on the board; therefore the directors were entitled to make the deal. At the same time those who got the option obtained a bargain. The profit realized on working account during the past 11 months was £16,967, and after deducting

Northern Queensland.

other expenses there remains a net profit of £12,187. All this money, except £500, is utilized in writing off plant, equipment, etc. When the mine was taken over in July last year the reserves stood at 334,000 tons; now they are 980,000 tons, assaying 3·25% copper and 2·66 dwt. gold per ton. In addition, there are 'probable' ore reserves of 250,000 tons assaying 3% copper and 1·5 dwt. gold per ton.

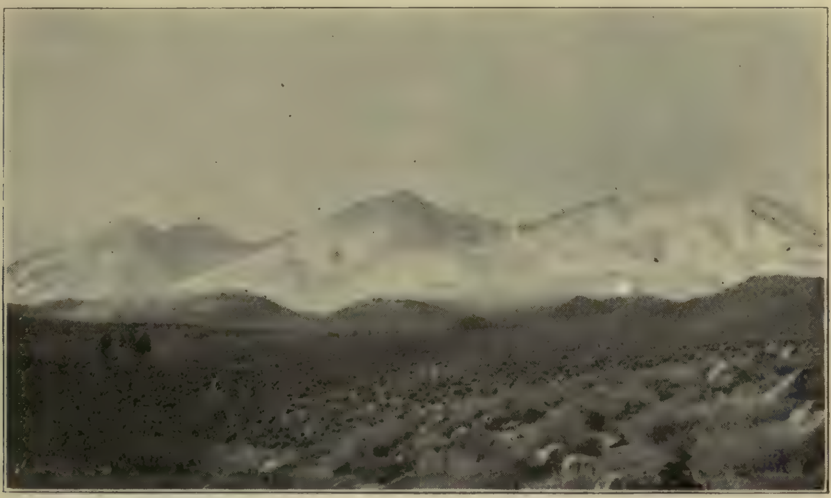
Great Cobar.—Technical men in Australia do not altogether accept the dicta of J. D. Kendall, consulting engineer and director of the Great Cobar, as to the causes leading to the failure of the smelting plant. It is questioned whether plant could not have been made in Australia to do all the work required without having to rely on American designs and manufacture. The admission is made that the furnaces were structurally weak in a certain part, and the evidence is not clear that there may not have been other defects. Of course, if these defects were evident in one furnace and the three furnaces were of one model, then Mr. Kendall is right in complaining that the others should not have been put into commission until it was proved that they were not defective. But what we in Australia want to learn is why local material and local talent could not have been utilized to provide suitable furnaces for treating Cobar ore. What is fifty times worse is that the directors should not have had their consulting engineer on the spot when the plant was being got ready; no throwing of blame on the other chap absolves Mr. Kendall and his co-directors from responsibility in that matter; otherwise the value of a consulting engineer is nil. There was the more reason for this as the furnaces were of outside design. Then the question arises whether there was the harmony between the board, the general manager, and the consulting engineer that there should have been. The other issue that is begged by the report of the directors is the grade of the ore: the tonnage treated last year is given at 221,512, including purchased ores, while the output was 4726 tons of copper. Therefore the grade of the ore was 2·1% copper. This would be about right as the average contents of the ore at the No. 10 level is given at 2·57% copper. But Mr. Kendall advised the board that the cost of production would be £34 per ton of blister copper. It was not till inquiry was made from H. C. Bellinger, the new manager, that the information was vouchsafed that such costs were right for a 3% ore, and that the cost for a 2½% ore would be £40! This a slight difference; it is no use figuring on a 3% ore when it is not there. To the Australian miner the weak point of the Cobar proposition is the grade of the ore, especially at the bottom level.

SAN FRANCISCO.

Oil Development in California is proceeding with great rapidity. Though the State lost the first place as a producer through the extraordinary discoveries in Oklahoma, at the present rate of exploration the old rank will soon be regained. In fact, California ranks first to-day in point of value for its output: In 1908 the yield was 44,854,737 bbl., commanding an average spot price at the wells of 52·25 cents, which amounted to $23,433,502. A remarkable fact in connection with this is that the price is by no means a high one. The opinion prevails among the people of California that greater competition is needed, and that a freer market for coal should be obtained in order to give cheaper fuel oil. In the Eastern fields, however, in competition with cheap coal, the prices for crude oil at the well are greatly in excess of those obtained in this State. For example, in Pennsylvania, the price is $1·7912, and in West Virginia, $1·776. Illinois stands second in regard to value, the output of 33,685,106 bbl. in 1908, bringing $22,648,886, or 67·2c. per bbl. Oklahoma produced 45,798,765 bbl. which commanded only 38·6c. per bbl., making a total value of $17,694,843. Competition in the oil business in California is actually keen, the Union Oil Co. proving aggressive, and successfully maintaining its position as a rival of the Standard Oil Co. The most important new development has been in the Coyote hills near Los Angeles, where excellent producing wells have been 'brought in' by both the Union and Central oil companies. An interesting circumstance is the great depth of these wells. In the Coyote hills the oil-stratum lies as deep as 4400 ft., and the Union Oil Co. has just completed the Brashear well, seven miles west of Los Angeles, which penetrated to a depth of 5323 ft. The well cost $40,000. A large territory of supposed deep-seated oil strata exists in California, and bold exploration to these great depths is being conducted by many operators.

Smelter-smoke is still making trouble for the copper and lead smelters of the State, and the opposition in Shasta county has assumed an aggravated form. The farmers have organized a protective association, and after unsuccessful efforts to adjust matters through the agency of a committee appointed to wait upon the smelter representatives, a peremptory order was issued by the farmers that the smelters should show proof by October 1 that immediate relief would be provided, otherwise—the *dénouement* is left to the imagination. The principal damage is said to occur at points as much as 20 miles from the smelters. The fact that sulphuric anhydride has been transported that far without condensation has not been fully substantiated, yet it seems to be true. During the high temperature prevailing in the Sacramento valley during the summer months such an occurrence may be possible. It is feared that extensive litigation may follow. The smelters involved are the Mammoth, at Kennett, belonging to the United States Smelting, Refining & Mining Co., and the Balaklala, at Coram, belonging to the Balaklala Consolidated Copper Co. The Mountain Copper Co. at Keswick is apparently not involved in the contention, its smelting being almost wholly done at Point Lewis on San Francisco Bay; neither does the Bully Hill smelter seem to contribute to the fume complained of, owing to its remoteness and to protective topographic features. This latter smelter belongs to the General Electric Co., but is operated by a subsidiary corporation known as the Bully Hill Copper Mining & Smelting Co., the local office being at Winthrop, Shasta county. The suit for dissolving the injunction against the Selby Smelting and Lead Co. has again been postponed. It is expected that the Cottrell electric precipitation process for the solid matter in the fume will be in operation for all gases emanating from the works within the next three weeks.

Refrigeration. — News from Nome, Alaska, points to some interesting technical developments. It sounds odd to apply refrigeration to mining as a means of holding back seepage waters, but such is the claim now made. The cost of pumping is so high that the mining of the gravels by bedrock drifts is often prohibitive except when the ground is frozen. In one case it is reported that the cost of freezing artificially has proved less than that of pumping. The engineer of the meat company was called in to aid the miner, a rather interesting circumstance. The adaptation of such a system would seem possible only to wet strata in which the water was not in motion. In the utilization of the Poetsch-Sooy-Smith freezing process for shaft-sinking practical immobility of the water in the sand and silt was found to be a prerequisite for success. Only high value of the material excavated could warrant the application of refrigeration as a means for restraining mine waters, but the wrinkle is worth remembering. It would be interesting to have the details of method and cost. The Wonder Dredging Co. is said to have made arrangements for keeping its dredge-pool artificially thawed so as to be able to work until January 1 at least. If economically successful the method would lead to a much more extensive dredging of the tundra, since such prolongation of the season will enable suitable profits to be won. At the opposite extreme from the use of artificial freezing in underground mining is the Alaskan practice with the 'steam-point,' which is employed to loosen the gravel for stoping. Between seven and eight acres of bedrock have been cleaned in this way, at the Union mine, near Nome, the stoping width being about five feet (18 in. of bedrock gravel and 3 ft. of the schistose



In San Bernardino, California.

bedrock itself). The steam-points are 6½ ft. long, and are set horizontally 18 in. to 2 ft. apart, the output being about ten cars of pay-gravel per point per day.

TORONTO.

The Cobalt stock market has been depressed for a long time; the midsummer dullness is normal, but as the season advances there is no indication of improvement, still less of such activity as characterised the market last fall. The public appears entirely apathetic, even news that a year ago would have created speculative excitement is now ineffective. One cause of this apathy is the number of companies appealing to investors. The new camps of Gowganda, Elk Lake, and South Lorrain divide public attention with Cobalt proper, and a vast amount of capital has been swallowed in enterprises that have been unable to secure sufficient funds for development, owing to the bewildering multiplicity of inducements held out to the speculator. Naturally those whose money is locked up in this manner are disposed to be cautious as regards further commitments. Hence many really good prospects that have attained a fair degree of development find their shares quoted to-day at lower figures than when they were mere holes in the ground. Another reason for the depression is the passing of dividends by several companies, including the Silver Queen, Temiskaming, and Coniagas, and the consequent want of confidence in the stability of Cobalt stocks as an investment.

Production.—Meanwhile at the camp itself activity in development and production is steadily increasing. The August output was 2604 tons, and the shipments for the first eight months of the year amounted to 20,608 tons, as compared with 25,361 tons for the entire year 1908. It must also be borne in mind that with the more extended introduction of concentrating machinery the value of shipments is greater, a large proportion of this year's output being in the form of rich concentrate instead of low-grade ore.

The Gillies Limit. — This is a tract 64,000 acres in extent, which was reserved by the Government when the Cobalt area was located. The edge of this tract extends into the mineralized area of Cobalt, and it was long a debatable question as to whether it was rich in silver. The Provincial government undertook prospecting and mining operations, and did considerable work at the Provincial mine, from which two shipments of ore were made last year. No information has ever been obtainable as to the value of the ore, but on reaching a depth of 140 ft. production ceased. The Government then abandoned its policy of running the mine as a public undertaking and has been selling off lots on the northern portion of the Limit, subject to a 10% royalty and other conditions. One of these properties was purchased for a few thousand dollars by J. H. Waldman, of Montreal, who at once put a large force of men to work and in a few weeks uncovered rich ore. Seventy men are now at work on the mine and a depth of 42 ft. has been reached. A sample taken from the 30 ft. level assayed 10,668 oz. silver per ton. A company has just been organized with Mr. Waldman as president. The course of the Government in the matter has been keenly criticized and it certainly does seem as if with all the scientific and financial resources at their command the authorities should have been able to obtain some notion of the real value of the property which they transferred so cheaply. Subsequently, on September 15, the Government sold the Provincial mine to F. M. Connell, of Haileybury, for $113,111, subject to a royalty of 10% on the gross output. Altogether 15 properties were sold to various buyers, the total 349 acres fetching $223,054.

New railroads.—The members of the Ontario legislature took a trip to Cobalt and the adjacent region, with a view to ascertaining the needs of the mining country. One result is likely to be a considerable increase in the annual appropriations for development purposes. The great need is better means of transportation, especially railways. The government wagon-road from Elk Lake to Gowganda will be finished in time for the winter traffic. This region will shortly be much more accessible, as the Canadian Northern Railway has been extended to within 34 miles of Gowganda. The Quebec government also intends to expend money for the development of the mining districts. Speaking recently at St. John's, the Premier intimated that his government intended sending mining engineers to the Chibogomou district and if their reports substantiated the claims made for it by prospectors a railway would be built to the camp. At present the nearest road is a hundred miles distant, and the transportation difficulties are debited with the failure of numerous mining companies.

NEW YORK.

Cobalt.—At the offices of the mining companies operating at Cobalt, Ontario, there is much alarm over the local sanitary conditions. Many miners are down with typhoid fever, and the efficiency of the working forces is much impaired. The situation is serious. Plans are being considered by the leading companies to aid the town in providing a thorough drainage system. Cobalt now has a population of nearly 8000 people, yet there it has no sewerage system.

Dividends.—The directors of the Nipissing Mines Co. have declared a dividend of 5% and an extra dividend of 2½% for the quarter. Heretofore the company has paid 3% per quarter, as a regular disbursement, and 2% as an extra. The Nipissing company announces an ore reserve of $8,000,000. The capital is 1,200,000 five-dollar shares. Nipissing shares have risen to $12½ on the increase in the dividend rate. The directors of La Rose Consolidated (recently 'listed' on the London Stock Exchange) declared the quarterly dividend of 3%, with 1% extra. The capital of this company is 1,500,000 shares of $5 each. The quotation is around $8. Another Cobalt mine, the Crown Reserve, has just paid a quarterly dividend of 6% and an extra of 9%. This required the disbursement of nearly $300,000, the par value of the shares being $1. Nipissing disburses $487,500, and La Rose $300,000. For the first eight months of 1909 the Cobalt mines have paid out $4,333,300. Dividends will exceed $6,000,000 for the year.

New methods. — Two companies that manufacture tunnelling machines have established their offices in New York. The Fowler machine is designed to bore a 'square' hole. It has a number of air-drills arranged on a head, which swings from side to side. The Terry, Tench & Proctor contrivance bores a circular 8-ft. tunnel, using hammer-drills of a standard type arranged upon a revolving head, which automatically elevates the broken rock and deposits it on a belt-conveyor.

Mexican business. — The Exploration Company of New York announces that the net earnings of the Guanajuato Consolidated, in Mexico, have increased from 8000 pesos in February to 47,300 pesos in August, largely as a result of improvements in mill-practice. The Guanajuato Development Co., whose activities have resulted in the investment of several millions of American money in Guanajuato mines during the past three or four years, is promoting the Oro Grande Mines, which has taken over a number of the old bonanzas in the La Luz district. The selling of the shares is being done by the Securities Corporation. Cortlandt E. Palmer, lately in charge of the operations of the Guanajuato Development Co., has brought suit for breach of contract. The General Development Co. is preparing for the rapid opening of the Mexiamora of the San Cayetano group, at Guanajuato. The Mexiamora was recently unwatered from the adit-level. The Carmen Guanajuato mill is nearly completed. The Proprietary Mines Co. reports the Tajo de Dolores mine at Guanajuato in 'bonanza' below the fifth level. The shareholders of the Santa Gertrudis at Pachuca have approved the option given on the mine by their directors to the Camp Bird company, and the deal will now go through. The Santa Brigida in western Chihuahua is being offered for sale here. W. C. Greene contracted to purchase it for the Greene Gold-Silver Co., but when that corporation failed during the panic, there was default in the making of promised payments and the options lapsed.

Copper.—Copper producers are becoming convinced that the price of copper metal will sag under increasing production until the railways come into the market. Copper wire must be ordered for electrification of steam roads before the existing surplus can be materially cut down and the price of the metal radically advanced. It is said that the Tuolumne mine at Butte, Montana, has developed an orebody 15 to 25 ft. wide, 8 to 12 ft. of it averaging fully 10%, and the remainder better than 6% in copper. The orebody is already known to be continuous for 395 ft. This development is the most important in Butte for many years. 'Porphyry coppers' continue to have the call on the 'curb.' Miami, Ray Consolidated, Gila, Nevada Consolidated, Cumberland-Ely, Inspiration, Ray Central, Giroux, and Ely Central are all active. The Thompson interests are said to be getting out of Cumberland; it is believed in the Street that this is done in behalf of Inspiration, which they are backing and which they consider the bigger mine. The strike of miners at Cumberland-Ely is not yet settled; the local management does not appear to be putting forth any very strenuous efforts to effect a settlement. Ray Central has been weak on bear raids 'engineered' by a house that is financing a promising prospect at Ely, Nevada, called Ely Central. Oscar A. Turner, who made his money out of the Tonopah, invested the greater part of his fortune in copper claims at Ray, Arizona. These claims were acquired by the Ray Central Co., now controlled by the Lewisohns. Turner exchanged his interest for shares, which he has been selling to support the market for Ely Central, a stock that is now active on the 'curb.'

REDRUTH.

Journalists' Visit.—During the month of September the Journalists' Institute held their meeting at Plymouth and afterward a group of about 100 members visited the engineering works of Holman Brothers, at Camborne. They then went to Dolcoath, where they were entertained at lunch by the directors, and afterward inspected the new machinery at South Crofty—the next dividend payer. Another group travelled to Penzance by rail and then by motor to Botallack mine, St. Just.

Wheal Commerce.—Local people place the accent emphatically on the second syllable. This property is cheaply worked, the ground being a clay-slate or 'killas,' which is easily mined and stoped. The engine-shaft has been sunk 70 fathoms, and is well equipped with a double cage-road, and substantial head-gear, with crusher attached, driven by electric motor. A horizontal engine actuates the Cornish pumps. The mill is conveniently near the shaft and connected by means of a well-built trestle suitable for double tracks. In the mill there are 10 stamps of the California pattern, having a capacity of 40 tons per day, with Wilfleys and Frue vanners for 20 stamps; in fact, the building was designed for 20 heads. The mill is driven by a gas-producer plant and a 90 hp. electric engine. Sinking will shortly be resumed. The surface plant is well designed and well built. Outside the mill there are Acme tables to treat the slime.

Belowda Mine, Roche.—Here a substantial engine-house is being erected for the accommodation of a Cornish pumping-engine to work a new mine, as the present shaft is only some 100 ft. deep. This is practically a virgin property, and it is confidently anticipated that it will prove a big success, as several lodes are known to traverse the sett. None of these have been developed below 200 ft. The crystals of tin found in this locality are exceptionally large.

Goss and Tregoss.—A local company has been working here for two years. For six months an Australian syndicate has been at work drilling holes with a 3 in. augur through the alluvial, most of which, if not all, has been 'streamed' or worked by 'Phœnicians, Romans, Jews,' right down to within the last 20 or 30 years. This syndicate was encouraged by the result of the drillings of 100 or more holes to purchase the property and a company is now being registered. They are now making a road across the moor to bring in a powerful engine suitable for a dredge, to exploit the whole of this extensive tract. Dredging is being conducted in other parts of the world at a cost of threepence per cubic yard. If such cheap work can be done here, and there is no reason why it cannot be done, this stream will add materially to the tin production of Cornwall, and encourage similar work elsewhere in the county. An effort was made some years ago to get possession of parts of the river Tamar, in order to dredge, but the experiment was not completed.

Carnon Valley.—During the early part of the year 50 holes were drilled to test the value of this immense deposit of sand and slime. It has been reported that some of the holes were 70 ft. deep. Several tests have been made of this sand deposit on a small scale in 10 and 20-ton lots, one of which when carted to a distant mill is reported to have yielded 10 lb. black tin per 2240 lb. but the systematic drill-tests did not give quite such a high average. A plant is now being built to treat 50 tons per day in a frame building 125 ft. long and about 30 ft. wide; and if this trial plant is successful other units will be added. The deposit has been drained by a system of ditches to a depth of from 3 to 8 ft., which it will be trammed to the testing plant when completed. The syndicate is well financed and is in the hands of a successful operator who has been fortunate in securing a placer man with American experience as assistant. From the main Falmouth and Truro road to the railroad viaduct is over a mile; an average width of 650 ft. and a depth of sand 30 ft. show that 12,000,000 tons may possibly be available.

South Crofty.—A discovery that may prove important has recently been made at South Crofty, where at 160 fathoms a cross-cut has intersected a lode, the first 5 ft. of which was rich in copper, while the remaining 16 ft. assayed well in tin and arsenic. The full width of the lode has not yet been ascertained.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

West African Mines.

The Editor:

Sir—I was much interested in Mr. Curle's article on West African mines, in your first issue. Though Mr. Curle appears afraid that the directors of West African gold mines will resemble Naaman the Syrian, I venture to hope that the resemblance will prove true in its entirety; for Naaman was persuaded to follow the advice given him and was healed. It was the prophet's servant, who, trying to make a secret commission for himself out of Naaman's gratitude, was punished by becoming "a leper as white as snow." A warning example to all traffickers in secret commissions! Seriously speaking, I wish to endorse Mr. Curle's advice to "get rid of the mosquito." When it is a question of establishing a permanent industry, which is to flourish in an unhealthy climate, it becomes of vital importance to abolish this factor of unhealthiness, and as necessary to spend money for this object as for establishing ore reserves. This fact was wisely recognized and acted upon by the constructors of the Panama Canal, and the results achieved there should be an object lesson to all who live in tropical countries. The expense was certainly no bagatelle, but no one who knows the Isthmus now will doubt that the expenditure was wise and is reaping its reward. First attention was given to sanitary arrangements, drainage, water supply, and war on mosquitos. The latter was carried on by draining all stagnant water, covering with kerosene or wire netting all water in tanks and barrels, enclosing in wire netting all the houses of white people, so that they look like gigantic meat-safes, and clearing all jungle and scrub around the dwellings. The result is that the yellow-fever mosquito, which breeds in the neighbourhood of dwellings, has been practically exterminated; yellow fever no longer exists, and the malarial mosquito, the *Anopheles*, is only now dangerous to those whose work takes them into the jungles and swamps away from the settlements. The Canal Zone is a health resort now compared to what it was in the time of De Lesseps, only a very few years ago. The example of the Panama Canal Zone should be imitated by every mining camp and town in West Africa. Conditions there are, I believe, already considerably improved, compared with what they were say ten years ago, but much still remains to be done, and money for such an object should not be stinted. In the long run it should have as much, if not more, influence on the reduction of working costs as increases in crushing plant, not to mention the safeguarding of human life.

W. F. A. THOMAE.

London, September 21.

The Principles of Mining.

The Editor:

Sir—There is much to be learned by friendly discussion. With that idea in view the following remarks are offered upon Mr. Shockley's criticism of what he justly describes as H. C. Hoover's remarkably clever book.

There are without doubt many men whose experience, were it put in print, would afford profitable reading; but not many of them upon attaining great professional success are able and willing to describe their methods for the benefit of others. Mr. Hoover, with characteristic modesty, disclaims credit for originality, yet the book is alive with information never before published. There are many novel ideas, and if, as the author says, they are the common heritage of the profession, let us thank him for introducing them to us.

The question of the extension of orebodies in depth, is one that gives the examining engineer constant food for thought. Each mine brings its own problems and the engineer who can see beyond the point of his pick is the one who reaps the great rewards. Any rule that can be applied, any yard-stick that can be used, is a welcome adjunct to our equipment. Methods differ, so it is natural that there should be differences of opinion on a point of such vast importance. Mr. Shockley quotes the useful empirical formula given in Mr. Hoover's book, but apparently misinterprets the clear meaning of the words. The author does not state that the ratio of depth to length is any indication of the *maximum* extension in depth, but on the contrary tells us "this is not proposed as a formula giving the total amount of extension in depth, but as a sort of yard-stick" by which we may measure the probable *minimum* extension of the orebody downward. The author restricts this to fissure veins. Mr. Shockley's citation of various well known deep mines appears to me to have no critical bearing on the subject.

The accuracy of Mr. Hoover's statement that "the minimum stoping width which can be consistently broken with hand-holes is about thirty inches" is by no means vitiated by naming a few isolated cases where a narrower stope is carried; nor do coal mines enter into the discussion. Citing the Mansfeld copper mines as evidence seems to me to bear about the same relation to the generally existing state of affairs as a wheelbarrow does to an automobile as a means of locomotion. The Mansfeld works without a government subsidy would be closed to-day. Thousands of acres of stopes on the Rand contradict Mr. Shockley's contention and sustain Mr. Hoover's. That a man can work in a narrower stope is not denied, but bearing in mind the economic result desired in all mining operations, there can be no doubt that during the past twenty years some one of the many hundreds of engineers would have introduced a narrower stoping width on the Rand, had it been possible thereby to reduce working cost. Nor can it be gainsaid that a narrower stope may be more comfortably worked in a highly inclined than in a flat deposit. However, on the Rand, where all inclinations are encountered, from vertical to almost horizontal, the result of experience is that a stoping width of 30 inches has been adopted throughout the district.

Regarding the efficiency of labour, the annexed table from Mr. Hoover's book is worth quoting. Undoubtedly contract prices with coloured labour may be less than with white labour, but increased cost of supervision levels the difference. In S. J. Speak's paper, quoted by Mr. Shockley, the total costs for mining and treatment are higher than those attained in California, despite vastly superior physical conditions and cheap coloured labour. In the Kolar mines, with a somewhat less tonnage than in the Australian and American mines, there were required one-fifth as many whites besides an army of 13,611 natives.

Group of Mines	Tons of Material averaged on compiled period	Average number of men employed		Tons per man per annum	Cost per ton on material broken
		Coloured	White		
4 Kolar mines	963,950	13,611	302	69·3	$3·85
6 Australian mines	1,027,718	—	1,534	669·9	2·47
3 Witwatersrand mines ...	2,962,640	13,560	1,595	195·5	2·68
4 American mines	1,089,500	—	1,524	713·3	1·92

It is an unintentional indictment of the host of managers handling coloured labour for Mr. Shockley to state that "similar low costs will be reached in mining and other departments of human labour when this cheap labour is properly organized and administered." Again I must cite the case of the Rand with 1595 whites and 13,560 natives for less than three million tons as against 1524 whites and no coloured labour for one million tons in the United States. Mr. Shockley surely does not mean that the coloured labour on the Rand is not properly organized and administered. Such being the case, when may the mining industry expect the millenium predicted? Is it not better to take cognizance of the fact that more than mere muscle is required to attain low working costs; that environment, competition, and ambition play an important part, and that no amount of organization or administration will make the coloured races the equals of the white races? The knowledge of how to carry out the work, the tenacity of purpose to complete it, and the other qualities that the white man possesses and the coloured man does not possess, will always necessitate the employment of such a large number of white overseers as to make the final costs as great with coloured as with white labour.

If I am not trespassing too much on your space, Mr. Editor, I would venture one more remark. Mr. Shockley says he would like to know the names of some precious-metal mines that could be recommended as a proper investment for trustee funds. The implication is uncalled for; on page 181 Mr. Hoover warns the reader in the following words: "Far from denying that mining is in comparison with better class government bonds a speculative type of investment, it is desirable to avow and emphasize the fact." In discussing the same principle on page 183 the author, in comparing mines to other commercial enterprises, remarks : "But eliminating this class of enterprise (natural monopolies) the speculative value of a goodwill involves a greater risk than prospective value in mines." These are only two random quotations showing the intention of the author. The perusal of the book as a whole leaves no doubt in my mind that he considers all mining enterprises speculative to a varying degree. In conclusion, I can only hope that at some future date Mr. Hoover will write more on the subject of which he is so thoroughly the master.

London, September 28. C. S. H.

Investments and Speculations.

The Editor:

Sir—There appeared, anonymously, in the first number of *The Mining Magazine* a classified list of mining shares. It was a masterly piece of work. After perusing it I said—in the words of Conan Doyle's great sleuth-hound—"This is the work of Professor Moriarty!" Your readers, Sir, may think I jest (and yet I really do not) when I say there are only two men in England who could have done this. I am one; but it was not I. The other is a man, known to me, whose attainments in this sphere of knowledge are perhaps not inferior to my own. This masterly classification proclaims him quite surely as your anonymous correspondent.

How simple they look, these five columns of names! Yet I wonder if your readers grasped just how many hundred thousand miles of travel, what powers of generalization and finance, and how much inside knowledge of the world's metal mines is represented in their arrangement. It was no fool who did this. There is subtlety in this list, but only for the elect; as an example, note Amalgamated Copper figuring in column No. 4; and oh! the infinite pathos of finding highly puffed Utah-Bingham among the tripe. But I must not digress. Space will only permit me at this time to reconstruct the mines in column No. 1, which, with the 'Professor's' permission, I shall now do. Ivanhoe and Horseshoe remain as shown; Mount Morgan, after reflection being relegated to column No. 2. Prestea Block A and Cinnamon Bippo stand. Prestea is one of the show mines of the world to-day. Cinnamon Bippo has perhaps the intrinsic value of neither Abosso, Taquah, nor Ashanti Goldfields, but is better at the price. It is a fine stretch of banket, where all the ore yet exposed is payable, and where, as Mr. Curle has pointed out, working facilities are better than at any spot on the Tarkwa range. Mexico Mines of El Oro I relegate, bringing instead into column No. 1 Alaska Mexican and Alaska United. Among Broken Hill mines, the North and Block 10 remain in column No. 1. The Central mine of the Sulphide Corporation would rank with these but for the immense width of lode and the corresponding risk of 'creeps.' Zinc Corporation, not being a mine, I do not classify.

As to copper, let me be one of the first to tell the world of the real stability of the new 'porphyry' mines. These, producing great quantities of copper at £35 or £40 per ton, can face any metal slump; and their ore reserves are immense. In column No. 1 I place the four biggest porphyries: Nevada Consolidated, Utah Copper, Ray Consolidated, and Miami. Arizona Copper is a mine of this type, but on its relatively high valuation is placed in column No. 2. I allow none but these four porphyry mines to figure in column No. 1.

Allow me, in conclusion, to point out that the Transvaal and Indian mines still await classification in this list.

ARTHUR GUTSFORD WORPLEDON.

London, October 5.

Metallurgy on the Rand.

The Editor:

Sir—It is with considerable interest and a great deal of pleasure that I read Mr. Lane Carter's article appearing in your last issue, and I wish that a great many other men engaged in the profession of metallurgy in South Africa were given the opportunity to study the methods being followed in other countries, and at the same time to get out of the groove into which one is so apt to fall when stationed on the Witwatersrand.

The main feature of Mr. Carter's article is his frank admission that it is since he has left South Africa that he has learnt to be sceptical about some of the operations which during his residence on the Rand, he, like most other professional men, had accepted as orthodox. In presenting his new impressions with so little apology and in admitting the possibilities of improvement in Rand practice that have since suggested themselves to his mind, Mr. Carter at once shows his ability to forego a long sustained practice when it proves to be obsolete, and to adapt himself to the improved conditions which he has found in other countries.

Mr. Carter refers to the Homestake company's work in South Dakota, and as I have had the privilege on several occasions of going through the Homestake mine and equipment, and of investigating other work in the neighbourhood, I can fully corroborate the statements made by him. I would also like to call attention to the fact that in this same district there are three other excellent illustrations of what can be achieved in the way of a treatment plant on a basis of capital outlay and operating cost that can compare favourably with the best work that the Rand has achieved. In fact it has, to me, been a matter of continual surprise that more attention has not been drawn to the accomplishments of other countries when compared with the metallurgical work of the Rand. I make no apology for referring to these comparisons, as on more than one occasion in the past I have had the temerity to ventilate my views before the technical associations at Johannesburg, and it will not surprise my friends if I champion the statements made by Mr. Carter or presume to extend them further than he has done. The opportunity, however, to do this, where the charge of partiality could be eliminated, has not before occurred.

The three other illustrations to which reference has been made above are the Wasp No. 2, the Great Mogul, and the Lundberg, Dorr & Wilson mines, all situated in the neighbourhood of Deadwood, South Dakota. The first mentioned company treated for several years a 2 dwt. ore at a profit, on a crushing basis of about 300 tons per day. Certainly the mining conditions favoured an extraordinarily low cost, and, in fact, they partook more of the nature of quarrying than of mining, but the treatment of the ore and the general running of the whole business gives an illustration of economy in handling and treating ore that for the capacity of the plant and for the ore crushed per day, is the best record that has ever come to my notice. The ore is crushed in stages before treatment by percolation in a weak solution of cyanide. The total cost of the whole operation of mining and milling, inclusive of all charges and contingencies, averaged about 5 shillings per ton.

The Great Mogul company completed the erection of a plant capable of handling 400 tons per day for £25,000, inclusive of crushing plant, consisting of crushers and rolls; fine-grinding plant, consisting of edge runners—to which tube-mills have since been added; percolation sand-treatment plant; and a Moore filter-press; the whole complete with all the necessary details such as pumps and so forth. On the Rand a plant with a capacity of 400 tons, complete in the same detail, would cost at least twice as much, and there are many instances in which the decantation-plant alone, for a smaller capacity per day, has cost double the sum mentioned. There are reasons why in the United States the capital outlay on plant would naturally be lower than in South Africa, the main one being that the bulk of the machinery can be purchased and delivered for a lower figure. But this difference does not in itself explain everything, and the more important factor in this consideration is the difference in the design and general character of the plant.

In operating costs, too, there are local conditions in favour of South Dakota as compared with South Africa, but again there are other reasons why it is possible to work on a small capacity for a lower figure than on the Rand. Among the factors of local importance may be mentioned cheaper power; absence of abnormal head-office and general charges; better residue-handling facilities; and low development cost. Electric power can be purchased for about £20 per annum per e.h.p. paid on the actual power used. Head-office and general charges are kept down to quite a normal figure; residues are in many cases sluiced down gulches requiring no expensive impounding; and, in addition, in the flat formation there is practically no shaft-sinking; no heavy pumping installation; no expensive stations, pumps, etc., and many other features of local importance.

The inclusive costs on the Lundberg, Dorr & Wilson mine are under 10s. per ton and at the Great Mogul the figure stands at about the same level, while at the Wasp No. 2 it stands at just over 5s. per ton.

When it is considered that these results have been achieved in the face of great difficulty and by men who have not had the opportunity to study the results of hundreds of adjoining mines as one may do on the Rand, and when it is remembered that large amounts of capital for development and equipment purposes have not been readily forthcoming, it must be conceded that the successes made are all the more meritorious. The Lundberg, Dorr & Wilson equipment consists of crushers, rolls, edge-runners, percolation-vats, and the Moore filter-press. Cyanide solution is circulated through the entire plant beginning at the edge-runners, and about 30% of the ore is treated in the filter-press plant. The owners of this property, when they first designed their equipment, were confronted with the knowledge that all efforts to treat their class of ore by amalgamation had up to that time been an utter failure and they were therefore forced to resort to other methods. Their boldness was rewarded with success, and they have been able to make a steady recovery of something like 80% by the circulation method where old-time methods had been an utter failure.

A study in detail of the records of the operations of the three companies mentioned will satisfy a most careful investigator of the excellence of the work done and of the success of the introduction of the factors of fine-grinding and filter-pressing. The Moore filter-press made its first success here, and this was largely due to the individual efforts of J. V. N. Dorr; indeed, the successful development of the vacuum-filter of the Moore type may be said to date from the inception of the work in this mill.

The tendency of American, as compared with South African, practice is to grind finely everything and treat the whole of the ore as one product through filter-presses. In South Africa the millmen have devoted their attention to augmenting the weight of gravity stamps, to increasing their decantation plant, and to retaining the outline of the scheme of treatment developed 15 years ago, rather than to taking advantage of the experience of other parts of the world. Almost by force local metallurgists were made to adopt tube-milling, after bitter opposition. They have still clung to their faith in decantation despite the fact that in no other country in the world is the decantation method still included in up-to-date gold treatment equipment. This persistence has been maintained, regardless of initial capital outlay, extraction, or operating cost. It is safe to say that on the simple ores of the Witwatersrand the interest and depreciation on the sum that would represent the difference in the first capital cost as between a decantation plant and a vacuum-filter plant of equal capacity *and* efficiency such as the Ridgway or the Moore, would represent at least 25 to 30% of the treatment cost per ton of either plant if calculated on a basis of 500 tons per day. This is a bold statement to make, and far-reaching too, in the light of its reflection on the losses that have been voluntarily incurred by the sponsors of the decantation process on the Rand.

Just as surely as fine grinding had to come to the Rand sooner or later, so must filter-pressing, and if a little more enterprise and a little less conservatism had been shown by local metallurgists in the last ten years, these things would all have been done before now. From 1902 to 1906 I did my utmost to push forward these views at Johannesburg, and although they have to some extent been followed, there still remains a good deal to be done before the whole programme is realised ; but however slow the movement may be, it is one that in the nature of things is inevitable.

The decantation process when first introduced was a great achievement, and one for which J. R. Williams and his associates deserve every credit, but it was only a stepping-stone in the progress of slime-treatment, and regarded in that light only, it should have been duly removed when science had clearly demonstrated the fact that more economic methods had been developed in other countries.

Mr. Carter refers to the zinc-dust precipitation process and I must confess that when I was shown the total-precipitation plant at the Homestake I was struck by its extraordinary simplicity as compared to our Rand zinc-shaving method. Two V-shaped filter-presses represent the total extractor-box capacity on the Homestake slime-plant where over 1000 tons of slime is treated each day. There is no shifting of zinc and none of the other laborious processes that attach to the long open-box method, and no danger of theft. The whole operation consists of feeding metallic zinc-dust into the pumps containing the solution to be precipitated. In the process of being pumped through the filter-presses, the precipitation takes place, the gold slime being retained in the press. In point of capital outlay, simplicity of working, and low operating cost, there is no comparison between this method and the old one. I see no reason why this principle should not be as well suited to the ores of the Rand as to those of the Homestake, and I am astonished that the method has not already been adopted there.

Mr. Carter believes that it would be a mistake to discard amalgamation on the Rand. I can understand his prejudice to dispensing with an operation that has been so successful and which accounts for so large a percentage of the total gold recovered, but I believe—with the circulation of solution right through the plant, and the fine-grinding and filter pressing of the whole of the pulp—that the design of the whole metallurgical equipment would be simplified to such an extraordinary degree, and the capital outlay so enormously reduced, that this step will eventually be taken.

So far as the recovery of the gold is concerned, it makes no more cost and involves no added consumption of cyanide to recover all of the gold by that method, while it does away with one of the commonest sources of theft in existing gold-treatment practice. I am prepared to admit that it will take a long time to satisfy the Rand that it can profitably abolish amalgamation, sand-percolation treatment, and the decantation treatment of slime, but I am perfectly confident that in the due evolution of metallurgy all of these steps will be taken.

H. S. Denny.

London, October 4.

Goldfields of Madagascar.

The Editor:

Sir—I send you a short account of the northern goldfields of Madagascar, in the hope that it may be of interest to your readers.

The northern goldfields of Madagascar are situated three days journey south of the town of Diego-Suares in the extreme north of the island, and 30 miles inland from the west coast. The journey from Diego-Suares is accomplished in a *philanzana* or light carrying-chair, the traveller being carried on shoulders of the natives. All supplies for the mines are conveyed in like manner, but a road is now being made by the Government, and 30 kilometres is completed.

The principal properties are owned by Mortages & Gregnon, under the syndicate name of Les Mines d'Or de l'Andavakoera. The mines themselves are situated on some small hills on the margin of a large plain. This plain extends in a northeast and southwest direction; to the south are the hills traversed by the quartz veins; on the opposite side of the plain are the sedimentary rocks, in a bold escarpment showing a dip north and northwest to the sea. South of these small foothills there is evidence of a dyke, and beyond the micaceous schist reaches away to the crystalline rocks, which are the backbone of Madagascar.

So far only the quartz veins carrying visible gold have been worked, and little is known as to the value of any ore in which gold cannot be seen. This is due in a measure to the mode of working; the owners, having no capital, have worked the mines on the tribute system, and the tributers naturally work on the rich spots and 'leaders,' the gold being sold to the owners of the property at tenpence per gramme. Thus the owner is enabled, without spending a penny on labour, to get his mines exploited for him. On the other hand, he has the disadvantage of having "the eyes picked out" of his mines, and at the end of the year finds that his development work has made no progress.

By the wasteful methods above described over two tons of gold have been produced by the Andavakoera mines within the last two years, which speaks well for the richness of the deposits; it must be noted that the natives know next to nothing about gold mining, and the mode of reduction is the primitive one of crushing the gold-quartz between stones, or pounding it with hammers.

From the foregoing it will be apparent that at present it is impossible to obtain reliable information as to the average value of the orebodies.

The village of Ambakirano, which is in the most central position for the mines, is situated on the plains on the left bank of the Mahajeba river, and is fairly healthy, there being very few mosquitoes or other insect pests. There is a certain amount of bilious fever, but with care this can be prevented.

There is a good general store run by a Greek and the usual grog shop. Fresh bread and beef can be obtained every morning at reasonable prices. The rainy season commences on this coast about October, and the dry season in March. January and February are considered the wet months. The best labourers are the Taimoros from the south-east of the island; they are tractable and make fairly good workmen. Twenty francs per month and their rice is the usual pay for carriers and odd-job men; the miners (being mostly on tribute) have at present no recognized scale of pay. The Taimoros are a happy good-natured people, short, but well proportioned, and capable of hard work. There is a saying in the colony: "If you feed a Taimoro well, he will stick to you for ever." Labour is fairly abundant.

George G. Dixon.

London, October 2.

MINING ACCIDENTS IN CORNWALL

By AN OCCASIONAL CONTRIBUTOR

OFFICIAL figures show that during the last few years the death-rate in Cornish mines has increased. The present time is opportune for criticism and suggestions.

Examining roof in slate mine, in North Wales.
Photograph by J. C. Burrow, Camborne.

Cornwall forms part of the Southern district (officially called No. 12). The inspector is Joseph S. Martin; in his report for 1908, he states that the underground death-rate was 2·77 per thousand. In 1904, 1905, 1906, and 1907, the rates were 1·99, 3·71, 3·62, and 2·39 per thousand respectively. In the North Wales district (No. 7) the inspector, Henry Hall, reports a death-rate in the metalliferous mines of only 0·56 per thousand during 1908. From past records it appears that twenty-five years ago the death-rates in the North Wales and Cornwall districts were practically identical, averaging 1·55 per 1000. It is noticeable, therefore, that while the liability to fatal accident has increased in Cornwall, it has decreased in North Wales.

During the four years 1905-'08, the total number of deaths in Cornish mines was 55. One of the victims was over 60 years of age, 3 from 50 to 60, 9 from 40 to 50, 5 from 30 to 40, 22 from 20 to 30 and 13 from 15 to 20 years old. The ages of two were not specified. These figures show that 24½% were 40 years of age and over, whilst 74½% were under 40; 66% were under 30 years of age, and 24·52% were under 20 years of age. These are painful figures; too many young men were killed. It will be found in every industry that the aged and experienced rarely get killed, therefore it is not always policy to discharge experienced men. The table shows a death-rate of 9·43% for miners between 30 and 40 years of age. This may be largely due to the fact that other mining countries, such as Africa, United States, Canada, Mexico, even the Gold Coast, offer better inducements for men of that age.

The accompanying table gives the cause of the underground accidents, classed under four heads:

Year.	Falls of Ground.	Shaft Accidents.	Explosives.	Sundries.
1905 ...	7	4	0	2
1906 ...	5	4	2	3
1907 ...	3	4	1	3
1908 ...	7	4	0	1
	22	16	3	9

	Percentage.
Falls of roofs and sides account for	44
Shaft accidents ,, ,,	32
Explosives ,, ,,	6
Sundries ,, ,,	18

We are too often reminded that "accidents will happen in the best regulated families," but there is no reason why mines should court accidents by neglecting safeguards. Take the case of falls of ground. Mr. Martin in his 1908 report says: "If critics had experience in both classes of mining, and would bear in mind the size of the huge cavities in some of the metalliferous mines, and the utter impracticability of complete and careful examination being made frequently," etc. Is Cornwall the only mining district that has "huge cavities?" It is the only mining district where the huge cavities are not filled. Compare the second paragraph on page 28 of Mr. Martin's report with the third paragraph on page 28 of Mr. Hall's report. The latter says: "All accidents from this cause happened through falls from some place within reach of the persons injured. There was none from falls of roof or sides of pillars in slate mines." There was not one fatal accident from fall of ground, whereas in Cornwall the accident rate for mines was 1·62 per 1000.

The accompanying photographs from a slate mine in North Wales and from a Cornish tin mine, respectively, will show a difference as to the size of stope. For these photographs I have to thank J. C. Burrow, of Camborne.

The method of filling stopes is compulsory in Australia, and certainly should be compulsory in Cornwall, as it is much more economical, and certainly more durable than timber. Of the safety of filling stopes there can be no question; it is also economical, since it minimizes the quantity of waste rock to be hoisted, thus saving steam and space at surface, besides eliminating the cost of staging, not even 4 ft. being required, not to mention the 20 or 30 ft. not uncommon in Cornish mines. Fill the stopes either with the stoped ore, or with waste.

In mines where stull-timbers and lagging are expensive, only a little, if any, timber should be required in the stopes, provided that first a small level is driven just large enough for the cars, and over this level come the stopes, leaving a block of ground, about 6 ft. high, between the level and the stopes. If all the ore cannot be extracted by this method, there are no reasons why a continuous groove could not be cut on both sides of the level, and arched with waste rock. The process is simple enough: Put timbers across the roof of the level, and cover them with boards or planks, and on these place sand or fine dirt in the form of an arch, then lay the stone on the sand. When the arch has been completed, in 12 ft. lengths, the timbers can be taken out and used again. These stone arches are practically indestructible, not only as against explosives but even an earthquake.

The erection of stages on ladders 20 ft. high, or even higher, together with accessories, take 33% of the working time, not to mention the manufacture of useless matchwood from the 'Norway.' No stope—even if we ignore the question of safety to the miner—can be worked economically more than eight feet above firm ground. I maintain that any improvement able to pay for itself in any old mine in two years is justifiable; the manager is warranted not only in recommending it, but demanding it as a right. Even in mushroom mines an improvement is justified when it pays for itself in 12 months.

Next come fatal accidents in shafts. Surely this death-rate is too high, namely, 17 in four years. Last year the rate was 0·92 per 1000 as against no fatal accident in No. 7 district. It is known that Cornwall is not suffering from a superfluity of well-equipped vertical shafts at present. This may be regarded as a legacy from predecessors, but that is no reason why such an expensive policy should be continued; our fathers left us their picks and gads, but we have outgrown them. "That shaft knackt the bal." Hoisting with kibbles through cork-screw shafts with or without bed-plank is not mining. There are cases where the cage or skip would pay for itself in less than 12 months; first in the decrease of coal consumption, and next in wear and tear.

It is gratifying to see so few accidents from explosives; only three, or 6% of the total. Not a single fatal accident was recorded in either 1905 or 1908. In large mines, only specialists should be allowed to use and handle explosives, and in small mines the explosives should be largely used by careful miners.

Most of the Cornish mines to-day are managed by comparatively young men; surely there is an opportunity for these men to "win their spurs" by raising their mines from the danger to the safety zone. Napoleon said: "All the great captains have performed vast achievements by conforming with the rules of the art—by adjusting efforts to obstacles." Let safety become a real objective; place it first, and dividends will follow. Not one of the managers can enrich a lode, nor decipher Nature's laws. Talk is cheap in all mining circles about primary and secondary enrichment and even secondary impoverishment, about ascending and descending vapours and solutions. There is one thing which these young mine managers can do: they can see that the mines over which

Showing size of slope in a slate mine in Wales.
Photograph by J. C. Burrow, Camborne.

they rule shall be worked safely, and therefore economically.

Let the Mine Inspector recommend that every manager who has passed a year without the accident rate exceeding 0·25 per 1000 shall be entitled to special mention, also that the shift-bosses be encouraged in this work of life-saving.

John S. Walker, in writing on the coal mines at Gary, West Virginia, in the *Engineering and Mining Journal* for July 3 says: "The mine foreman, assistant mine foreman, and minor officials are paid premiums each month during which no one under their jurisdiction is seriously injured." Result: "Since the adoption of this method accidents of all classes have been reduced more than one half." Again: "The number of accidents occurring in proportion to the miners employed (3000) is the lowest, not only in the State, but in any other State, or in any foreign country." This colliery produced 100,000,000 tons in five years. The United States Steel Corporation, which controls the mines at Gary, and is the largest employer of labour in the world, believes that it is not economy to have a high death-rate, whether due either to accident, improper ventilation, or unsanitary conditions.

Miners everywhere know the dangerous parts of a mine, and, if possible, will give them a wide berth. When a fatal accident occurs in any mine, the miners do but little for the rest of the day, the manager feels his responsibility acutely, and all the officers are demoralized. Therefore the first requisite for a successful manager is to economize in life, in broken limbs, and battered heads. I would much like to see the report of the No. 12 district for 1909 even lower than the 0·56 of the No. 7 district, say, as low as 0·30 per 1000, and I feel sure that no one in England would be prouder of the achievement than Joseph S. Martin; such a low death-rate is possible if all the managers, shift-bosses, and miners themselves were as keen as the Inspector in taking precautions to prevent unnecessary fatalities.

Supporting a weak roof in the depths of a Cornish mine.
Photograph by J. C. Burrow Camborne

METAL MARKETS

COPPER.

Weakness began to develop in this metal early in the month, foreshadowing an unfavourable statistical position, which was fully realized, especially in the figures of the American Producers Association for August. These disclosed a decrease in deliveries for that month of 18,992 tons, which largely removed the good impression created by the returns for July. Realizations gradually drove the forward price from £60¾, at which the month opened, to £59, at the middle of September. From this point the market soon recovered, however, when it was seen that in spite of these poor deliveries the stocks had only increased 5625 tons, and with the single exception of July, were the lowest for any month since January. Consumers, impressed by the improved aspect, then commenced covering their immediate requirements, and the English government came into the market for good quantities, so that the price advanced to £60⅛ by the end of the month. A considerable consumers business was done on the Continent, and large lines were placed by the American producers with European buyers, which encouraged them to show a bold front and maintain their prices. Toward the end of the month reports of labour troubles in Montana induced some speculative buying.

The visible supplies in England and France on September 30 show an increase of 5633 tons, amounting to 93,851 tons, as against 88,218 tons at the end of August. The consumption is probably better than it has ever been, but it will have to increase still more to overtake current over-production. Judging from the decreased volume of shipments from America and the prospects of dearer money, the outlook for October is scarcely cheerful; on the other hand, buyers are badly supplied with stocks and any general firmness on the Stock Exchange might easily communicate a better tone to the metal market, creating a scramble for early deliveries.

Average prices of cash copper:

September, 1909	August, 1909	September, 1908
£59 3s. 3d.	£59 10s. 2d.	£60 8s. 6d.

TIN.

The expectation of better prices has not been fulfilled. The speculative activity exhibited in August had spent itself before the middle of September, and disappointment over the statistical position, the increase of 1700 tons in next year's Banca sales, the bull account that had been created, all contributed to depress prices from £138¾ (for three months tin) to £136¾ at the middle of September. The lower price proved attractive to consumers, who purchased freely, both in Europe and America; this, assisted by the firmness of the Eastern houses, who marketed small quantities, induced a revival to £141⅞, although the final price for the month is again about £1 lower. Trade prospects continue excellent.

Average price of cash tin:

September, 1909	August, 1909	September, 1908
£137 14s. 6d.	£135 18s. 3d.	£131 6s. 8d.

LEAD.

This market was dull during the greater part of the month, the trade being content with buying their requirements from hand to mouth, and showing no disposition to make forward purchases. Prices remained stationary at £12⅝ to £12$\frac{13}{16}$ until quite at the close of the month, when sellers found themselves so well sold that they did not care to part with further quantities except at an advance. The first sign of firmness brought in consumers freely, and each 2s. 6d. advance in price increased the anxiety to buy until £13 2s. 6d. to £13 6s. 3d. is being paid, with every prospect of diminished reserves and a further rise.

Average prices of soft foreign lead:

September, 1909	August, 1909	September, 1908
£12 15s. 3d.	£12 10s. 6d.	£13 3s. 6d.

SPELTER.

Record orders have been taken in galvanized iron, the dissolution of the Galvanized Iron Association having apparently given the impetus required to make exporters send out their orders. This commenced in August and has continued right through September with unabated vigour, giving rise to an almost unprecedented demand for the metal. The present rise in the price of spelter inadequately reflects the better trade conditions and the enormous demand for the metal. Interests outside of the convention have declared themselves out of the market for early delivery, and the convention itself, in spite of numerous sources of supply, seems to find it difficult to satisfy its heavy engagements. The price of £22½, at the beginning of the month, has been raised to £23¼, with prospects for a further advance.

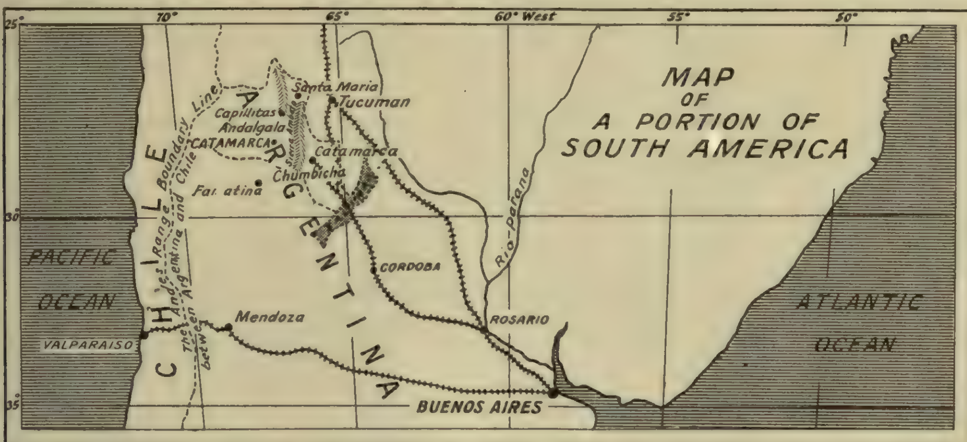
Average prices of good ordinary spelter:

September, 1909	August, 1909	September, 1908
£22 17s. 2d.	£22 0s. 3d.	£19 10s. 3d.

COPPER SMELTING IN THE ARGENTINE

By C. H. JONES

THE Capillitas mines are situated at an altitude of 10,000 ft. on a spur from the main range of the Andes, in the province of Catamarca, of the Argentine Republic. These mines have been worked for more than a generation through adit-levels. It was assumed that the workings could yield 50 tons of ore daily, but no preparation had been made for systematic stoping. Fuel was scarce, barely enough brushwood being obtainable for domestic use. From the mines the ore was transported over an aerial tramway 25 miles to Muschaca; the tramway was of the single rope type, the buckets being suspended by means of automatic gripping boxheads. Gravity was supplemented by steam. The tramway consisted



of four independent parts, each driven at its upper end by a 25 h.p. high-speed engine. The lower terminus at Muschaca was at an elevation of 3500 ft.; on the inclines the boxheads carrying the buckets often failed to grip the rope, so that delays were frequent.

Muschaca stands at the mouth of a valley that opens into a sandy plain 80 miles square, at 3000 ft. above sea-level. Across this plain all supplies and material had to be transported for 150 miles in two-wheel carts, holding $1\frac{1}{2}$ tons and drawn by six mules, to the railway at Chumbicha, which is nearly 1000 miles from the sea. A trip from Muschaca to Chumbicha and return occupied over a month. Fodder for the mules and food for the muleteers on the way had also to be carried. At the time the Company commenced operations the Government had promised to extend the railway close to Muschaca; but before this had been done the mining operations were suspended. The freight from Muschaca to the railway ranged from £3 to £4 per ton, but the service was interrupted during the rainy season.

At Muschaca the ore was dumped from the ropeway into bins, which had a capacity of 700 tons; they were 20 ft. high with a 45° bottom for the whole height and discharged upon the feed-floor of two blast-furnaces. These furnaces were supplied by Fraser & Chalmers; the area at the level of the tuyeres was 84 by 36 inches, and at the top of the jackets, 84 by 60; on each side were six 4 in. tuyeres. The row of jackets was 8 ft. 6 in. high with a brick super-structure of 6 ft. 9 in. to the feed-floor; this gave a depth of 15 ft. from the feed-floor to the bottom of the furnace. The gases were removed by a steel downtake (1 ft. 6 in. by 6 ft.) beneath the feed-floor into a brick flue-chamber (built on the furnace-floor), continuing by a masonry flue to an iron stack 40 ft. high, the total elevation from feed-floor to top of chimney being 88 ft. The tap-jacket was of steel and the spout of cast iron, water-cooled. Two portable forehearths, each 3 ft. 6 in. by 4 ft. 6 in., and 24 small slag-pots completed the outfit. The forehearths were not supplied with tapping-blocks, and so two pieces of $\frac{3}{4}$ in. cast-iron plates were screwed together and a tap-hole drilled through them. This lasted until some castings could be obtained from Rosario, a thousand miles away. The nearest point at which any machine-tool work could be done was at the railway-shops at Cordoba. The blast was supplied by two Roots blowers direct-connected to two vertical engines; they were listed to run at 180 r.p.m. and to deliver 28 cu. ft. air per revolution; both blowers delivered into one 3 ft. main pipe from which branches were taken to the two furnace bustle-pipes. The engine-room also contained a 50 h.p. horizontal engine for driving a No. 3 Gates crusher and a single paper-friction hoist that would lift half a ton vertically, and there was also a 50-ampere dynamo for furnishing light. The power was supplied by two Babcock & Wilcox boilers using cord-wood fuel.

The water for the furnace-jackets was drawn from the stream running through the valley to Muschaca. Only during rainstorms did this water reach Muschaca; it usually disappeared in the sand a few miles higher up, and so a pipe-line was laid to a point in the valley where water was available for nine months in the year.

Twenty miles from Muschaca on the sandy plateau was the old smelting establishment. This was erected in the middle of the forest for the sake of the wood fuel used in the reverberatories. The furnaces are curiosities; they were built of stone and clay, lined with brick made on the spot from silica and kaolin derived from decomposed granite. The hearth had an area of 100 sq. ft.; 1½ tons was smelted every 4 to 6 hours, each charge being skimmed and the matte tapped completely on alternate charges. Each furnace consumed 14 tons of wood per 24 hours. From figures obtained during a short run with one of these furnaces, the smelting cost would work out at £1 10s. per ton of charge, producing 60% matte. Old records show that in 1870, 2560 short tons of ore were smelted, producing 540 tons of bar copper; from 1860 to 1881, 49,396 tons of ore were smelted, producing 7400 tons of Chile bars; at this time the ore was packed by mules from the mines 45 miles away and the copper was carried across the Andes to the Pacific coast. It was to re-smelt the slags accumulated at Pilciao and reputed to assay 5% copper that the two blast-furnaces were ordered, but unfortunately before the furnaces reached South America a more careful sampling proved the slag-piles to average under 2%, and at this figure there was no profit in re-handling them. As the furnaces were useless for the purpose intended, it was decided to erect them at Muschaca to smelt the ore available.

The charcoal used in these furnaces was made at Pilciao; the best was made in kilns formed from the old reverberatory foundations. The largest of these would produce 8 tons per month and five smaller ones would yield 6 tons apiece, or a total of 38 tons per month. An attempt was made to make charcoal by burning the wood in heaps, but the soil was too sandy to serve as an efficient covering, and the locality being subject to periodic high winds and no water being available to quench the charcoal when opening up a burnt heap, the yield was small and the quality poor, while on the other hand the charcoal made from the kilns was excellent in quality, giving only 9% ash.

This gives a general idea of the conditions under which it was proposed to start smelting on a scale of 50 tons per day.

Metallurgically the ore from the mines fell into two classes; the ore from the upper levels, called 'silicious,' assayed:

	%		%
Copper ...	10	Zinc... ...	5
Alumina ...	5	Sulphur ...	12
Iron	8	Insoluble ...	57

and about 7 oz. silver per ton, with traces of gold. This ore was of a friable nature, grey in colour, showing minute grains of free quartz and the kaolin derived from the enclosing rock. The other class, a 'pyritic' ore, came from the lower levels and assayed:

	%		%
Copper ...	6	Zinc... ...	1
Alumina ...	3	Sulphur ...	41
Iron	37	Insoluble ...	10

This ore invariably carried gold, sometimes more than an ounce per ton.

I found that the board in London had been advised that these ores could be smelted pyritically with little or no consumption of fuel, and this advice had been accepted without trial; consequently, in the erection of the furnaces, no provision had been made for roasting. The builders were strongly in favour of a side-hill site, hence the furnaces were perched on the side of a precipitous hill, necessitating extensive and expensive retaining walls. The furnace-floor was 40 ft. above the ground level; therefore the ore was discharged from the ropeway into the bins at a point 84 ft. above the ground. Roasting at the mines was out of the

Bullock wagon, from Pilciao to Muschaca.

question owing to absence of fuel, as the rope-way could only carry sufficient for its own engines, so the only possible place was at Muschaca; and roasting here meant a re-hoisting of the roasted ore a vertical height of 84 ft. Further, owing to the shortage of labour it was probable that not more than 60 tons of charcoal could be made per month at Pilciao and this would only have smelted 400 tons of roasted ore. Smelting in the old reverberatories at Pilciao was also considered, but apart from the impossibility of transporting sufficient tonnage thither by carts and mules, the operating cost and the delay in re-erecting furnaces would have proved prohibitive. In the old days, during the successful running of this establishment, the ores packed there assayed more than 25% copper.

At this time the one cry of the Board was that matte must be produced; the only chance of paying current expenses was to try and smelt pyritically, although from the outset it seemed dubious whether with the plant at our disposal it would be possible to achieve economic success. The labour available was very inferior; not one of the men had seen a blast-furnace before, although a few that had worked on the Pilciao reverberatories knew matte from slag and were not afraid of moving molten liquids. I had the assistance of two young furnace-men from the Michigan College of Mines, named Houston and Pearce; without their help and interest in the experiments it would have been hopeless to attempt to run the furnaces.

General view of Smelter.

Our first trouble was with the main

Transport between Muschaca and Chumbicha.

spout; the furnaces had been intended to resmelt slags with a low air-pressure; the difference of level between the top of the hole in the tap-jacket and the nose of the spout was barely three inches, and when the pressure in the furnace rose to 14 oz. the blast would blow out through this main tap-hole. To remedy this, the spout was raised one inch and an inch iron strap was bolted across the nose of the spout, which was sealed with clay; thus an air-pressure of 22 oz. could be trapped, but unfortunately this was the limit because the level of the outflowing slag was now up to the level of the tuyeres. The forehearth was lined with two inches of common clay-brick and the matte was at first tapped into portable pots, but owing to the frequency with which the furnace-men failed to plug the tap-hole we afterward ran the matte into sand-beds arranged in a circle in front of the forehearth so that the men could work at the tap-hole from the middle of the circle. This arrangement worked far better with the class of labour available, as the hole only needed once plugging for each tapping. Slag was handled in small pots and tipped over the retaining wall of the furnace-floor.

Details as to the blowing-in with charcoal may be of interest: A fire was lighted on the hearth with the tuyere-caps removed, then charcoal was gradually added until it rose above the tuyeres; when by looking through the tuyeres this was seen to be nicely burning, the blower was started at about 10 r.p.m. and the caps were put on; charcoal was then added little by little taking care that the flames had burst through the last charcoal addition before more was added. In all, one ton of charcoal was used. This operation had to be done cautiously; if the blast was too strong the charcoal was blown out and kindled unevenly; if too weak or the charcoal was added too fast, the blast became choked and carbon monoxide was formed, as we found to our cost on one occasion when the feeders had added the fuel too rapidly, with the result that the flue-chamber became filled with the carbon monoxide, and, on a flame bursting through, this became ignited so that the whole brick arch over the flue-chamber collapsed. Ten starting charges were then weighed consisting of 500 kilo. mixed slag and matte from the cleaning of the forehearth from the previous run and 100 kilo. charcoal. Two of these charges were added and the blower gradually quickened to 100 r.p.m.; the rest of the charges were then added at five-minute intervals, one eye being kept on the furnace pressure-gauge and one on the smoke-stack to make certain that the blast was passing through the furnace. By this time the furnace was filled to one foot below the top of the jackets. The blower was kept at 100 r.p.m. until the slag reached to the level of the tuyeres; this took about three-quarters of an hour; then the main tap-hole was opened and the blower quickened to 140 r.p.m. All this had to be done cautiously; if the furnace was run too rapidly, and the tap-hole could not be opened smartly, slag would be running out of every tuyere. Ore, one ton at a time, was then added as the charge fell, keeping the level just below the top of the jackets, and about an hour after the first ton of ore had been added the blower was quickened to 160 or 170 r.p.m., which was the maximum rate that the trap-spout would permit.

The fine stuff was removed from nearly all the ore smelted, so as to keep the furnace as open as possible. The first attempt only lasted 30 hours, the trouble being that, owing to the want of sufficient trap on the spout, the blower could only be run at 120 r.p.m. The next run started with 11 charges of:

220	kilo.	Silicious ore
780	,,	Pyritic ,,
50	,,	Slag
50	,,	Coke

(I had a small quantity of hard coke as a stand-by. This cost £9 per ton and at the start I used it to break in the furnace and the furnace-men.)

Then followed 11 charges of 250 kilo. silicious ore and 750 kilo. pyritic ore, with 50 kilo. slag and 40 kilo. coke.

Then 59 charges of 300 kilo. silicious ore and 700 kilo. pyritic ore, plus 30 kilo. coke.

At six o'clock next morning, I changed to:

350	kilo.	Silicious ore
650	,,	Pyritic ,,
50	,,	Slag
30	,,	Charcoal

and on this charge we ran into the third day, when the smelting, which had been gradually running slower, stopped. During the first 18 hours 77 tons of ore were charged into the furnace; during the next 24 hours, 71 tons; during the next day, 44 tons; and during the last nine hours, 14 tons. The matte from the last tapping ran 31%, but the average from this run (producing 45 tons) was only 23% copper. Although this was encouraging it seemed impossible to blow enough air into the furnace to smelt the charge fast enough to avoid a gradual cooling down. The tuyere-caps and sight-holes leaked badly, not being intended for the pressures we were using. It was noticed during this run that the steel downtake became red hot from the escaping gases and this incidentally warmed the blast-pipe, which passed near it, and also reflected heat to the tuyere-pipes on one side of the furnace until they were appreciably warmed. The furnace seemed to smelt better on this side than on the other cool side. In consequence of the steel downtake becoming heated so much, it was completely destroyed after four days and had to be replaced as best as possible, namely, by a brick downtake built-up on steel rails.

The other furnace was then started on the same lines, but with charcoal only, and after two more attempts I became convinced that the silica put into the furnace was not in a physical form suitable for pyritic smelting. The silicious ore unquestionably contained some free quartz, but this was in fine crystals held together by kaolin and other silicates. However, at this time I got hold of some massive quartz rock (containing no copper) from the mines and also a smaller amount of porous quartz (80% SiO_2) carrying 8% copper, as malachite and chalcocite. In the next run I started thus:

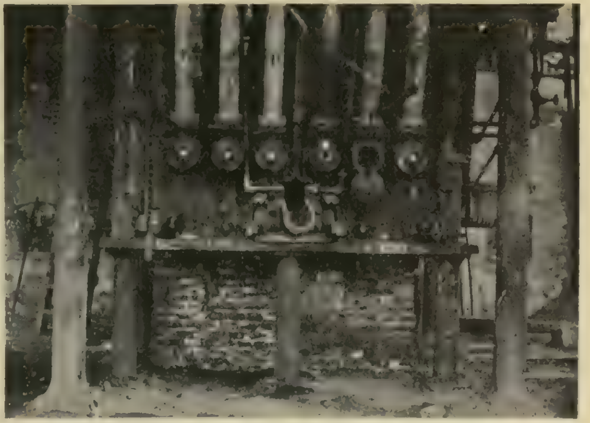
Hoisting low-grade matte.

Charcoal oven at Pilciao.

750 kilo.	Pyritic	ore
150 ,,	Silicious	,,
100 ,,	Quartz	,,
50 ,,	Charcoal	

The furnace ran much better than before; although the quartz ore was exhausted after two days, the furnace remained in blast for 5½ days, smelting 287 tons of ore and 30 tons of 'barrings' (from digging out the furnaces after previous attempts) with 20 tons of charcoal (including the two tons for blowing-in). No coke at all was used. The steel downtake on this furnace also was burnt out and had to be replaced by a brick one. The great drawback of a downtake under the feed-floor was that the top of the charge was 7 ft. below the charging-floor, and at this distance it was not possible to do anything in the way of barring down accretions while running.

We now went back to the first furnace fitted with the brick downtake —a month's heartbreaking work. No quartz was available and with the ores at our disposal it seemed impossible to get the furnace to run more than 24 hours; the only occasion when it did keep going for 48 hours was when we were able to get 50 kilo. quartz on each charge. It seemed impossible even to reproduce the runs of four and five days that we had previously made, although the ores and all conditions seemed the same; then it struck us that the only change from the previous runs was that we now had a brick downtake, which did not get heated through,



Blast-furnace at Muschaca.

in place of the steel one. Undoubtedly the slight heating that the blast got from this red hot steel sheet was helpful. It was also at this time the coldest month of the year, the thermometer occasionally touching the freezing point at night.

After exhaustive trials it proved useless to attempt further smelting on our silicious ore, and as fortunately at the same time the pyritic ore was coming from the mine richer in copper (from 6 to 10%) and carrying an ounce of gold, we arranged for the ropeway to bring down nothing but this ore and quartz; whereupon results became more satisfactory again. Our best run was made on the following charge:

750 kilo.	Pyritic ore
100 „	Barrings
80 „	Quartz
50 „	Slag
40 „	Charcoal.

The furnace ran six days on this charge, taking 33, 34, 34, 34, 34, 37, 38, 38, 38, 43, 37, 10 charges, during successive shifts of 12 hours. On this occasion we had to stop for lack of ore in the bins, the ropeway suffering from a breakdown, but the furnace was running faster on the last day than on the first. The matte averaged 25%. On one or two occasions we tried to bring up the grade of the matte by increasing the quartz and running both blowers on the one furnace, and although by this means the matte reached 39%, the spout would not stand the increased pressure for long. In re-concentrating the matte with coke, I could use both blowers, the column keeping more open than with the ore and charcoal. The slag contained from 30 to 32% silica and from 0·5 to 0·7% copper.

The low-grade matte, which averaged 25%, was put through the Gates crusher and then hoisted to the bins above the feed-floor. We had some trouble in re-concentrating the matte. For this operation I invariably used coke; it is doubtful if it could be done with charcoal, but I did not experiment long enough to satisfy myself on this point. Generally we used to change over from ore-smelting to matte-concentration without stopping, and the reverse. A usual charge was:

400 kilo.	Matte (25%)
100 „	Quartz
100 „	Rich ore
70 „	Barrings
70 „	Slag
40 „	Coke

The rich ore assayed:

Copper	20%	Sulphur... ...	18%
Insoluble ...	34	Alumina ...	7
Iron	9	Zinc	5

At the first attempt it was found impossible with one blower to bring up the matte beyond 40%, and so both were applied to the one furnace at 120 r.p.m. and with this amount of air the required grade of 50% could be maintained. The shipping matte was passed through the Gates crusher set fine, and packed in double jute sacks holding 60 kilo. each. A typical assay of the matte, as shipped, was: Copper, 50%; gold, 6 oz. per ton; silver, 50 oz. per ton.

Toward the middle of the summer, the water-supply dwindled; it would have been impossible to run these furnaces for three months for want of water, and as the ropeway showed little prospect of increasing its carrying capacity, the Company decided to suspend operations. At the conclusion of this seven months of smelting, we had the satisfaction of knowing that we had been able to smelt all the ore the ropeway was able to deliver to the smelter, and also that we had smelted it much cheaper than by any other method available. Owing to the small capacity of the ropeway one furnace was not in blast more than 18 days in the month, and for the rest of the time the same labour was employed, on day-shift only, crushing and hoisting the low-grade matte, crushing and sacking the shipping matte, and cleaning out the furnace, etc. Selecting a month in which all the low-grade matte made was also brought up to shipping grade, the costs per ton of ore smelted were as follows:

Labour	Pence	
On feed-floor	9·5	
On furnace-floor (including half a blacksmith) ...	15·0	
On boilers and engines ...	8·8	
Crushing and hoisting low-grade matte	2·9	
Crushing, cleaning, and sacking matte for shipment ...	2·1	
Between runs for cleaning out furnace, re-lining forehearth, cleaning flue-chamber, etc.	7·8	
	——	46·1
Superintendent, 2 foremen, and 1 mechanic, ...		48·3
Material.		
Boiler fuel	15·3	
Charcoal used in furnace ...	31·7	

Coke used in furnace ...	53·2	
Wood „ „ ...	4·2	
Oil and engine-supplies ...	4·4	
Brick for forehearth and furnace bottom	2·3	
Furnace supplies, including steel, hammer handles, tuyere-cap gaskets, electric light carbons, lamps, etc.	4·6	
	—	115·7
17s. 6d. per ton of ore smelted		210·1

One furnace was in blast during this month for 18 days only, but the costs are for the entire month. If more ore had been available for smelting the item of 48·3d. for 'white' labour would have been reduced to a better proportion, but the other costs would have remained about the same. The usual pay for native labour was 2s. 6d. for 10 hours, but while the furnace was in blast the minimum paid per 12 hour shift was 3s., and the maximum 4s. 6d. The blacksmith, our most expensive native workman, received 8s. for 10 hours. Labour was scarce and independent, the natives would rarely work more than five consecutive shifts, while Sundays and the Saints' days were always a source of anxiety to those in charge. When the furnace was not in blast about half of the force would lay off. Other items of cost were: Charcoal £2 per ton at Pilciao and £1 for cartage to Muschaca; English fire-brick cost 4d. each, common clay brick made at Pilciao, 1d each; Portland cement, £12 10s. per ton; steel, 14d. per kilo.; iron, 3d. per kilo; lubricating oil, 8·4d. per kilo.; pine lumber, 5·6d. per board foot. Cordwood cut and delivered at Muschaca averaged 12s. per. ton.

United States Iron Ore Imports.—It is estimated that during 1910 the imports of iron ore into the United States will amount to 2½ million tons. This increase will not be due in any way to the recent slight reduction of the tariff; it is entirely a question of freight. The bulk of the imports come from Cuba. About 250,000 tons comes from Newfoundland, and 400,000 tons is expected from Spain. Increasing amounts now come to Pennsylvania from the Kirunavara mines, in Sweden, the figure for the 1909 shipping season being about 200,000 tons. The total imports during 1908 were only a quarter of a million tons.

The Rowley white lead process is in operation at Detroit and the works have a capacity of 5,000 tons per annum. Molten lead is atomised by a jet of steam superheated to a temperature above that of the melting point of the metal. The metal thus powdered is mixed with water and carried to an oxidising apparatus where the mixture is exposed to the action of a current of air under low pressure and continuously agitated for 24 to 36 hours. The lead is here transformed into basic hydroxide, which is then carried to the carbonating plant. In this plant the hydroxide is agitated in water in the presence of purified flue-gas containing 18% of carbonic acid. About 36 hours is required for the action, the resulting product being a white lead in a very fine powder that does not require further disintegration. The proposition sounds interesting and we wonder whether in practice it will fare better than most of the rivals of the Dutch process.

Chrome Ore.—Details of chrome ore production are given in the *Mineral Industry*, Vol. 17. The largest producer of chrome ore is New Caledonia, whence 46,309 tons were exported during 1908. Russia comes second, but no recent figures are available, the last report being for 1905, when the production was 27,050 tons. Canada produced 6,553 tons in 1908, chiefly from the eastern townships of Quebec. At one time Asia Minor was an important source of supply, but the amount shipped nowadays has fallen off. No official or dependable figures are obtainable. It is stated that many of the Smyrna companies have ceased production. Sources of chrome ore have recently been opened up in the Transvaal and Rhodesia. Greece and India are also small but regular producers. The only chrome ore mines in the United States are in Shasta County, California, but the output is unimportant.

Shippers to Mexico will be interested to learn that the disability of not being able to consign on a through bill of lading to interior points in the Republic has been removed, and these documents can now be obtained from all the steamship companies serving Mexican ports. Information regarding this and other matters relating to Mexico will be given on application to E. J. Bray, the general European agent of the National Railways of Mexico at Dashwood House, New Broad St., London.

The Guinea.

IN the year 1695 King William III took in hand a work which was then of urgency. He decreed a reform of the English coinage, called in all the debased money in circulation, and issued a new currency. Among the coins then for the first time minted was the guinea, so called because the gold from which it was first struck came from the Guinea coast of West Africa. The value of this coin was fixed at 22s., the English currency being then in theory bimetallic, as some systems of currency still are. After a time King William was surprised to find that his new silver coins began to leave the country as fast as they were turned out from the Royal mint. He endeavoured to check the drain by stringent enactments, prescribing heavy penalties on any one detected in exporting silver. The laws proved powerless. In spite of them the new silver coins, as fast as they were issued, were withdrawn from circulation and shipped abroad, either in their minted form or melted down into bullion. The King made yet more stringent laws against the export of silver, but in vain; and neither he nor his ministers were able to explain the reason for it. The matter was referred to Sir Isaac Newton, and that scientist had no difficulty in pointing out the determining cause. He showed that, at the relative market values of gold and silver as determined by the law of supply and demand, the new guinea was worth, not twenty-two of the new shillings as ordained by legal enactment, but only 20s. 8d. The result was inevitable. Merchants and business men of all kinds retained the appreciated golden guineas in the country and paid off their local liabilities at the rate of 20s. 8d. for every 22s. worth of debt; they sent away the silver coins to liquidate their debts abroad, since the foreign creditor would take the guinea at no more than its proper value of 20s. 8d. Sir Isaac Newton therefore recommended that the legal value of the guinea should be reduced to 21s., the value it nominally bears to-day. The King saw the force of the argument; he brought the guinea down to 21s., and withdrew his edicts against the export of silver. The appreciation of the standard gold coin, however, though now only 4d., was sufficient to cause a continuation of the steady drain of silver out of the country; and for more than a century England, though nominally a bimetallic country, was actually what she became legally on the great reform of the currency in 1816, a gold monometallic country.—*Monthly Journal* of the Chamber of Mines, Western Australia, June 30, 1909.

Protection of Investors.

THE Mining and Metallurgical Society of America has finally adopted the following resolution, and we commend it to the earnest attention of our readers:

WHEREAS: The overvaluation of mining properties by investors and the public, due to ignorance of mining conditions and a lack of appreciation of the real nature of the investment, tends to increase unduly the profits of mine promoters and speculators, and to increase unnecessarily the financial risks taken by mine investors, to the ultimate disadvantage of the mining industry,

RESOLVED: That it is the opinion of the Mining and Metallurgical Society of America that, for the protection of shareholders and investors, every mining company should publish an annual report within ninety days of the close of its fiscal year, and such report should incorporate the following information:

1. A brief review of the past history of the property, the work accomplished and the results obtained, with tabulated statement of expenditures and receipts from the beginning, marketable products made each year, and the sums received from the sale of same, the annual net earnings and the disposition made of such earnings.

2. A similar review, but in more detail, of the work of the year, with statements of the assets and liabilities (these statements to show all details as to capitalization of the company; the number and classes of shares outstanding at date of the report; the respective rights of these shares; the number of shares remaining in the treasury; any options or contracts on such shares; any bonded indebtedness), receipts and disbursements, cost sheet and other information as to work accomplished and results obtained.

3. A statement of ore reserves at the date of the report, compared with the reserves of the previous year, with an estimate, by competent authority, of the probable life of the mine.

THE ESPERANZA MINE, EL ORO, MEXICO

By W. E. HINDRY

THE ESPERANZA is one of the great bonanzas of the last decade, as is indicated by the record of production given herewith :

Year	Metric Tons	Gross Production in pesos	Operating Expense in pesos	Net Profit in pesos
1895	—	—	95,638	—
1896	5,239	178,296	114,764	63,531
1897	23,934	615,390	262,243	353,146
1898	24,105	855,267	391,673	463,593
1899	21,407	1,033,643	539,543	494,099
1900	49,865	1,291,473	664,280	627,193
1901	72,956	1,922,126	1,035,319	886,806
1902	77,417	1,947,616	1,183,511	764,105
1903	81,929	1,930,963	1,320,946	610,017
1904	127,888	3,037,609	2,228,677	808,932
1905	183,069	10,292,530	4,396,234	5,896,296
1906	207,182	15,357,690	6,157,085	9,200,604
1907	159,671	6,467,123	3,170,496	3,296,627
1908	153,105	4,317,164	2,461,580	1,855,584
TOTALS	1,187,767	49,246,890	24,021,989	25,320,533

The metric ton is equal to 2,204·6 lb. avoirdupois ; the peso is now equal to 50 cents U.S. currency, formerly it varied with the price of silver.

It will be noted that the expenditure of 95,638 pesos incurred during 1905 has been deducted from the net profit, leaving a total profit of 25,320,533 pesos. This large amount of money, approaching £2,500,000 sterling, has been extracted from underground workings having a total length of 13½ miles.

The Esperanza mine is situated in the district of El Oro de Hidalgo, in the State of Mexico, in the Republic of Mexico, in latitude 19° 47′ north and longitude 100° west. The little town of El Oro is 108 miles by rail northwest from the City of Mexico, and is reached by a narrow-gauge branch of the Mexican National railroad to Tultenango, from which station the El Oro Mining & Railway Co's. local railway brings the traveller to El Oro itself. The mine is thus placed within easy reach of a large city, amid climatic conditions favourable to continuous operation, with a railroad that runs to the mines and mills, in a region well watered and well timbered. The mining district of El Oro is peculiarly fortunate. Finally, and by no means least, labour conditions are good ; indeed, they are better than in any other portion of Mexico. The altitude is 9,000 ft. above sea-level ; this ensures a low average temperature throughout the year, namely, 50° F. ; the maximum heat is about 70° F., and even during the cold season snow is rare, and frosts are infrequent. The year is divided into two seasons : the rainy and the dry, the first commencing about the middle of June and lasting until October, the latter covering the remainder of the year, with occasional showers.

At a distance of about 30 miles from El Oro there are extensive forests, which furnish the timber and lumber necessary for mining and construction. Formerly these forests also furnished fuel for the generation of power, but this consumption of timber is now obviated by the use of electric power transmitted from Necaxa, a distance of 176 miles.

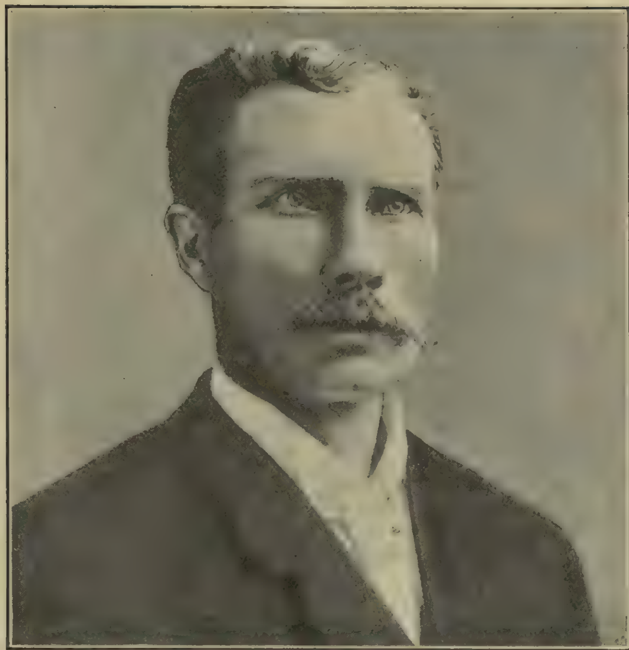
The Esperanza mine was originally 'denounced,' or located, by August Sahlberg in 1890 ; this enterprising miner opened up the mine and made it productive. Sahlberg was a Norwegian and came to the United States when only twenty years of age ; he drifted through the western American States for a number of years, working in the mines of Dakota and Montana, where he acquired a thorough knowledge of practical work. Having a venturesome disposition he came to Mexico in 1888, and shortly thereafter became foreman, and later, superintendent of the El Oro mine, which adjoins the Esperanza on the south.

Resigning his position, he devoted himself to the development of the Esperanza. In this work he showed perseverance under trying conditions. To perseverance he added a large fund of common sense, which was reinforced by unusual physical vigour. He was a powerful man of more than average height, with the broad shoulders and deep chest of the Scandinavian sailor. His early youth was passed on the coast of Norway, where he received only a rudimentary education, yet, when he died, in April 1903, he read and wrote both English and Spanish more correctly than many men of education. At the time when he was superintendent of the El Oro mine the San Rafael vein was the principal lode. In the upper levels of the El Oro the workings northward had run into andesite porphyry at a point immediately under the *barranca*, or ravine, which is still to be seen between the Esperanza and El Oro mines. It was supposed that the lode ended at that point, and that the ground northward was valueless. Sahlberg held other views, and in consequence of them, he located the open ground both to the north and south of the El Oro property. Shortly afterward he started a shaft on the Esperanza claim in order to sink through the overlying andesite, and cut the vein. This shaft, now enlarged, is one of the main openings of the Esperanza mine. The first sinking, of course, was done with a windlass, which, later was replaced by a small single-drum steam hoist. Sahlberg himself worked in the shaft and sank it until a heavy flow of water was struck. At this time also his money gave out, and he had no funds with which to purchase a pump. Then ensued a heart-breaking delay, for this happened just after the panic of 1893 and money was not obtainable for any enterprise however meritorious. Sahlberg borrowed a little from his immediate acquaintances and made a trip to the States with the object of laying his proposition before capitalists. He was wholly unsuccessful, and returned to Mexico City, where he finally succeeded in forming a Company known as Bumerango y Anexas, the stockholders of which furnished a small amount of ready cash. With this he resumed operations on the Esperanza. To get working capital Sahlberg had to surrender the larger part of his interest, but he was allowed to remain in charge of the mine itself. Thereupon he installed a boiler, a pump, and the necessary pipe, with which he un-watered the shaft, sank it a little deeper, drove a cross-cut to the west and—cut the vein.

At the point where it was first cut the vein did not carry pay-ore, but, by further driving and cross-cutting, some ore was found, sufficient to be encouraging. It was early realized that the ore was not rich enough for shipment to the smelters, and although, in 1895 a small tonnage was sorted and shipped in order to get a little cash, the plans for a mill were at once begun. The first mill contained 20-stamps followed by pan-amalgamation. The metallurgical treatment proved successful, and Sahlberg was now able to command money. He increased the holdings of the company and changed the name to Compania Minera La Esperanza y Anexas, S.A., with a capitalization of 3,000 shares, each having a par value of 100 pesos. The mine began to pay dividends, and, with his dividends Sahlberg commenced to buy back the shares that he had hypothecated, until he became one of the chief owners. For the next few years the Esperanza continued to make a handsome production and paid dividends of over 120%, until, in 1903, John Hays Hammond secured an option on the property for the Guggenheim Exploration Company. After a thorough examination made by A. C. Beatty and Louis Noble, the mine was bought by the Guggenheims for 4,500,000 pesos, equivalent to about £450,000. The new company was called the Esperanza Mining Company of New York; the majority of the stock was placed on the London market and a subsidiary English company was formed under the name of Esperanza Limited.

Under these new owners the mine did only fairly well, until October 1904, when a cross-cut on the fourth level, driven westward from the hanging-wall drift on the San Rafael vein, cut two other veins, afterwards known as the 'West Veins.' One of these was poor, but the other was extremely rich. By diamond-drilling it was quickly demonstrated that a new system of veins and large orebodies existed in this part of the mine. The necessary development work was pushed forward with all possible dispatch, and big reserves were rapidly exposed.

The result of this was shown by the production of 1905, and again in 1906, when the Esperanza mine became the most productive gold mine in the world. There is an old saying that "you cannot eat your cake and



August Sahlberg
(The discoverer of the Esperanza).

Street Scene in El Oro.

have it," and this has proved true in the case of the Esperanza. The production for 1907, although large, fell considerably below that of either 1906 or 1905, and it is hardly probable that this famous mine will ever again enjoy the distinction of being the greatest gold-producer in the world; but it is fair to add that the time has not yet come for writing an epitaph.

In general, in may be said that the veins of El Oro traverse shale, which is calcareous and carbonaceous. The veins are approximately parallel, with a strike of N30° W magnetic. The San Rafael vein, which passes through the Esperanza, El Oro, and Mexico mines, is the "mother vein" of the lode system; the shale is covered by a flow of andesite, which varies in thickness from a few feet to many hundred feet, so that the veins do not outcrop, and there are no surface indications of the existence of ore; indeed, as a matter of fact, both the San Rafael and Dos Estrellas veins were found by driving a blind adit into the mountain. The main features of the geologic history of the district have been ably summarized by J. E. Spurr, as follows:

"1. Deposition of a thick series of calcareous and carboniferous shales (probably pre-Tertiary).
2. Intrusion of andesite in the form of dikes and sills (earlier andesite).
3. Fault along northwest-trending planes. This faulting involved 1 and 2, it produced the great San Rafael fault (having a vertical component of movement of 1,000 ft., plus an unknown quantity) and minor auxiliary slips and fractures.
4. Deposition of ore by waters (probably hot and ascending) circulating along the fault and fractured zones. Along the San Rafael fault the San Rafael vein was formed and smaller veins along its auxiliary slips.
5. Faulting along northeast-trending and north-dipping planes, displacing 1, 2, 3, and 4, the general movement being downward on the north side. This period of faulting is represented especially by a large fault in the Esperanza mine.
6. Erosion and levelling of surface, planing off veins and orebodies.
7. Eruption of hornblende-andesite (later andesite) in the form of a surface flow; also in the form of intrusive bodies.
8. Further movement along at least one of the later northeast faults (the Esperanza fault) producing a displacement of the bottom of the surface flow of the later andesite.

"The San Rafael vein is a strong vein, following the zone of a heavy fault. It has a known extent, along the strike, of about 10,000 ft. and, since the fault-zone must extend downward a long distance, the original vertical extent of the vein was probably considerable. Most of the ore extracted from this vein has come (in the large sense) from a single chief orebody, part of which lies in the El Oro and part in the Esperanza ground. The orebody was exposed at the surface before the overflow of the later andesite and certainly some, and probably most of it, has already been removed by erosion. It has been displaced by northeast faults, chiefly prior to the later andesite flow. The San Rafael and its neighbouring veins belong to the Comstock type.

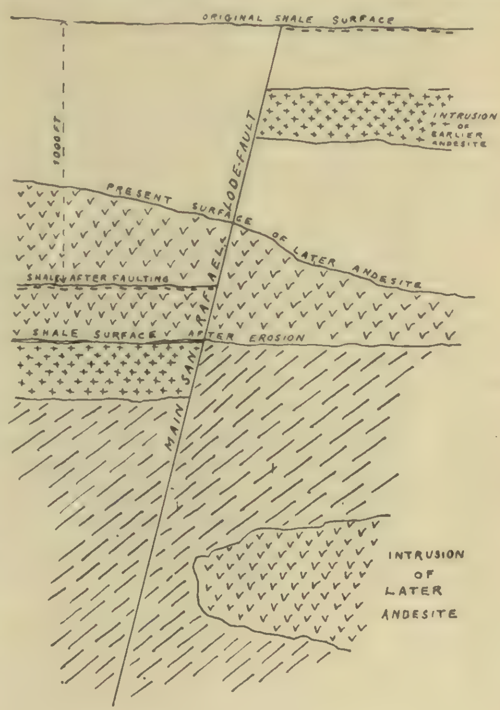
"Parallel to the San Rafael vein and within a comparatively short distance west of it, in the portion of the mine south of the Esperanza fault, there are smaller veins, one of which (No. 1) has yielded a large body of rich ore. These veins have formed along minor fault-zones auxiliary to the great San Rafael fault-zone." The accompanying map shows the position of the Esperanza in relation to its neighbours, the El Oro and Mexico mines.

It is only natural that the first equipment of the Esperanza should have been primitive in character; as is the case with most young mines, the equipment consisted of a few tools and the windlass necessary for sinking a shaft. Later a small single-drum Lidgerwood hoist and a fire-tube boiler were installed, with the necessary head-frame and shaft-house. When the shaft became wet, a No. 7 Cameron sinking pump was added, and after the San Rafael vein had been cut, a double-drum Lidgerwood hoist replaced the first winding engine, and at the same time single-deck cages took the place of buckets in the shaft.

As soon as the mine began to produce ore a 20-stamp pan-amalgamation mill was built, and this was shortly increased by the addition of 20 more stamps, with the necessary bins, rock-breakers, vats, pans, settlers, and so forth. The stamps weighed 850 lb. each, they dropped 6 inches 85 times per minute, crushing an average of 1·25 metric tons per stamp through a 40-mesh wire-cloth screen. The mortars were arranged for a double discharge, but it was found advisable not to use the rear opening. This mill was neither well designed nor well built, but it served its purpose. The total cost was 151,000 pesos and the capacity averaged 50 tons per day. The mill tailing was impounded, pending experiments for re-treatment. In 1898 a cyanide plant was constructed; this had a capacity of about 60 tons per day, and was later enlarged to a capacity of 145 tons at a total cost of 47,500 pesos. This plant gave excellent service and proved that the ore could be handled better by cyanidation than by amalgamation; thereupon Sahlberg decided to erect a new 120-stamp mill. On June 19, 1899, ground was broken for this new mill; on March 11, 1900, the mill was running, with only a break of 11 days between the shutting down of the old mill and the starting of the new. In the new plant the stamps weighed 950 lb. each, dropping 7 inches 103 times per minute. The entire mill when ready for operation cost 215,000 pesos. In 1903 a further addition was made, this taking the form of fifteen 5-ft. Huntington mills with the necessary adjuncts. Thus an increased capacity of 200 tons per day was obtained, at an expenditure of 145,560 pesos. The old tailing-plant was used for washing slime, and the results were so favourable that an additional slime-washing plant was installed under a separate roof at a cost of 13,808 pesos. In 1905 steam gave way to electricity. The electric installation cost 107,900 pesos. By way of comparison it may be stated that the entire mill, including slime - plant, concentrators, power - plant, machine-shop, precipitation-house, handling 410 tons per day, cost 551,238 pesos, or 1344 pesos per ton of average daily capacity.

In 1905 the Mexican Light & Power Co. made arrangements to deliver cheap electrical energy from their hydro-electric plant at Necaxa, in the State of Puebla, 176 miles from El Oro. As the use of electricity promised to be cheaper than that of steam, the necessary motors and apparatus were installed forthwith. All machines were arranged so that they could be driven either by steam or by electricity, this being necessary in the event of an interruption to the delivery of electrical power, for, it will be realized that in a mine like the Esperanza, having a large volume of water to handle, should power be cut off, even for a short time, the result would be disastrous. Some of this machinery was specially designed at the mine, and in many cases changes were made in so-called standard types of machines. Some of these eventually did not operate well in practice, but, on the whole, these modifications proved of undoubted advantage. In purchasing new equipment attention was paid to commercial efficiency, that is, machinery was selected that would give the greatest

Map of mining claims at El Oro.



Cross-Section illustrating the geology at El Oro.

efficiency as measured not only by the ratio of power delivered to output obtained, but preference was given to machines promising the most continuous service with the smallest repairs and delays, together with reasonable mechanical efficiency, in short, a machine that would be reasonably economical, and would stand continuous service under adverse conditions. These "adverse conditions," in the guise of incompetent operators, were always present, and the hard "continuous service" was sure to come sooner or later, so that the machine which failed at a critical moment entailed serious financial loss, more than enough to compensate for the difference in mechanical efficiency between the complicated and delicate mechanism on the one hand and, on the other, the simple and substantial device giving a lower factor of power output as compared with the intake, but which would operate 24 hours per day and for 365 days per annum. This was the general policy at the Esperanza and it was fully justified by results.

During 1906 the average number of men employed on the Esperanza mine was 3221. These men averaged 24·71 shifts per month —a remarkable showing for native labour. The average total cost of labour (native and foreign) was 7·35 pesos per metric ton. On the whole, the native labour of the El Oro district is exceptionally good, but the population of the district is insufficient for the demand made by expanding mining operations, therefore workmen have been obtained from other districts, such as Pachuca and Zacatecas. It has also been found necessary to increase the wages of the *peon*, or day labourer, so that it is nearly double what it used to be ten years ago. Thus, in 1897 the rate was 37½ centavos, while in 1908 this same class of labour commanded 62½ to 75 centavos per shift. Furthermore, while the rate of wages has increased the amount of labour performed per individual has suffered a decrease; in other words, the efficiency of ordinary labour has decreased to a serious extent. It is characteristic of the Mexican native that the more pay he receives the less work he will perform; if he can earn sufficient for his needs by working three days per week, he does not see the philosophy of working for six days. Surplus earnings are chiefly devoted to the purchase of *pulque* and other intoxicants, as well as other luxuries not conducive to physical fitness. It is true that the cost of living has increased and this has operated in a measure as a counter-irritant, so to speak, against a tendency toward idleness. Importations from elsewhere have not proved an unqualified success because the natives are reluctant to leave their *tierra*, or home place, and it is only the most venturesome, and the least responsible, that do so; and the best of these are apt to drift back to the place of their origin as soon as they have accumulated a little money. Many devices were tried to attract labour to El Oro; one of these was to pay a bonus for continuous work. It was customary to pay once a week, namely on Sunday, with the result that if any money was left on hand by Monday morning, the workmen were disinclined to go to work; by paying every day, however, the native got his money gradually, instead of receiving a lump sum, and as he spent it in the manner in which he received it, he was more likely to be in a fit state for work when he received his pay daily. However, it was also found necessary to introduce some form of contract, or task work, payment being made on results, as measured by the metre or by the ton. At the Esperanza the contract system was elaborated so as to include practically all classes of labour, the idea being to diminish the proportion of men at day's pay so that the expense of superintendence could also be reduced to a minimum. For breaking ore the price varied from 6 to 12 pesos per square set, in oxidised ore, and from 10 to 20 pesos per square set in sulphide ore; drifts and cross-cuts cost 20 to 40 pesos per linear metre; raises, 25 to 40; winzes, 30 pesos and upward. For timbering, 1 peso was paid per post, or 5 to 15 pesos per set. For tramming, the price varied from 15 to 20 centavos per car when filling from chutes, but the price was raised to 25 centavos when it became necessary to shovel. The ordinary labourer in a mill was paid 75 centavos per 12 hours. These figures will give some idea of the range of prices. It is proper to say that Mexican labour is not cheap, but if properly handled it is fairly satisfactory. Owing to the natural improvidence of the native workman, he never saves enough to keep his family more than a week or so; this effectually prevents serious strikes. Moreover, strikes and similar outbreaks are quickly repressed by the officials of the Mexican Government, so that any agglomeration of individuals planning to make such a move to the detriment of industry has to reckon upon repression from the authorities. As a rule the natives can be taught to use modern methods and machinery, but it is a

General View of El Oro District.

Esperanza Mine and Mill
(The Mexico Mine is in the background).

slow process, requiring both time and patience, especially if the act required is another way of doing something they have been accustomed to do in their own way; for example, great difficulty was found in enforcing a Mexican assayer to use a modern 'muffle' furnace instead of the old 'pot' furnace, to which he had been accustomed; the stopping of the custom of ceasing work in the middle of the forenoon and eating *almuerzo*, or breakfast, required months; and accustoming the native machinists to the use of modern high-speed steel on lathe and planer was an arduous undertaking; in fact, the breaking up of any old custom by the introduction of innovations was always attended with great difficulty and met with persistent opposition.

THE TRIAL OF THE PYX.—The Canadian mint was for the first time represented at the annual Trial of the Pyx, which was held in London in July. Probably few people know the nature of this function. It is an official test of the weight and fineness of samples of the coinage issued during the year, undertaken by the Goldsmiths' Company at the request of the Government. The ceremony is elaborate and the attendance of many distinguished officials is required. The proceedings end with a dinner at which many leading men in official and financial circles meet together. The mints, the products of which are examined at the trial, are, in addition to the Royal Mint, the branches established at Sydney, Melbourne, Perth, and Ottawa.

Copper.—The General Development Co. has been opening vast ore reserves at Miami, Arizona, the total now exceeding 28,000,000 tons, which will average higher than 2½% copper, perhaps as high as 3%. This company has also recently purchased the Planet mine in western Arizona on the recommendation of W. H. Weed. Persons identified with the Utah Copper Co. have become interested in the Chino copper mine in New Mexico, which is another large low-grade mine of promise. The day of the low-grade porphyry copper mine has certainly come, and ore reserves are reckoned in tens of millions of tons. The number of deposits of this character in America is large, and new ones are frequently reported, both in the United States and in Mexico.

Mining Regulations in Fiji.

According to the *Australian Mining Standard*, new mining regulations have been issued by the Executive Council of Fiji, in pursuance of the Mining Ordinance of 1908. The first part deals with prospecting. No prospecting may be done without a license and the applicant must indicate the area for which he desires sole rights in a most accurate manner. He must place stakes at each corner and indicate the lines between them by digging trenches, blazing trees, erecting finger-posts, etc. All such landmarks must bear the name of the claimant and the date of marking-out. Every three months the holder of a prospecting license must make a declaration of the amount spent, and a report on the work done.

A mining lease is granted for 21 years. If a transfer to other parties is desired, notice of such must be advertised three times in the Government Gazette. Creditors of the leaseholder thus have an opportunity of objecting to the transfer. Leases may be sublet, but in this case the original leaseholder is still bound by all his obligations, so that the relation of the leaseholder and the subleaseholder is in the nature of a partnership.

A royalty of 2½% is to be paid on all precious metals, other than gold, and on minerals, the values to be determined according to the prices obtained at Sydney. When ore is exported a government official will estimate its value; and an export duty or royalty of one shilling per ounce of gold and 2½% of the value of other ores must be paid. No ore can be put on board ship without the certificate of payment of this duty being shown. Ore thus exported can only be consigned to parties abroad approved by the Government. The regulations also demand that every leaseholder shall keep complete accounts of the quantity, contents, and value, of the ore raised, records of the labour employed, and full plans and sections (on a large scale) of the workings.

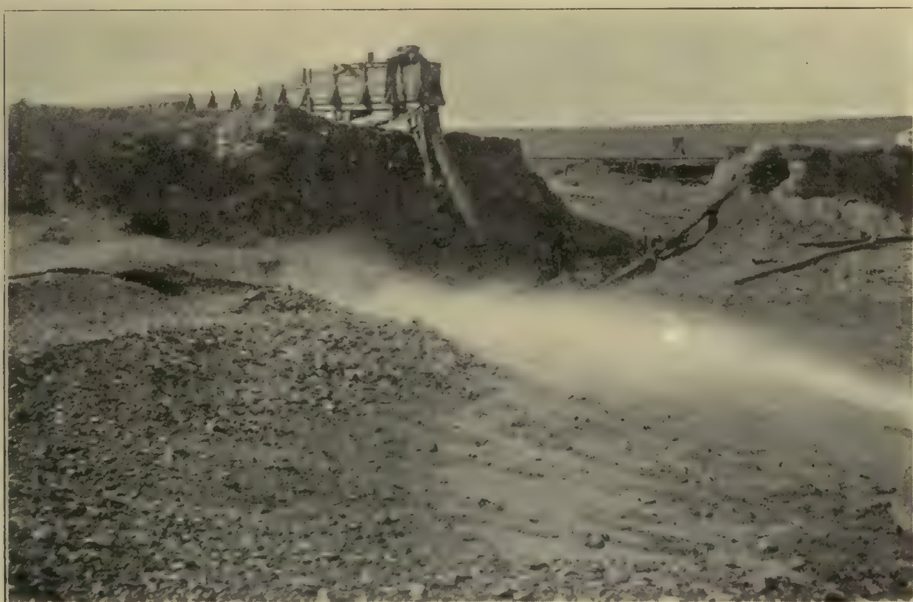
Radium.—The Ministry of Public Works at Vienna has received from the mines at Joachimstahl 154 grains of radium chloride, equivalent to 15½ grains of pure radium. This represents the entire production of 18 months' work and is valued at £20,000. The precious substance is enclosed within a lead capsule and is carefully guarded.

HYDRAULIC MINING IN ALASKA

By T. A. RICKARD

ALTHOUGH water is not plentiful and water under pressure suitable for hydraulic mining pre-supposes the construction of an expensive ditch, there are many examples of the employment of the hydraulic elevator in Alaska. The Miocene ditch enables the Pioneer Mining Co. to operate several of these water-lifts on Anvil and Glacier creeks; in the Teller district north of Nome the Ottumwa Mining Co. has three of them in operation; and the Wild Goose Mining and Trading Co. has four on Ophir creek. It is to the last mentioned locality that I shall go for an example of this class of mining. On the Discovery claim the hydraulic elevator was being used to work ground that was located in 1898 and had been worked in the usual way by drifting. The gravel as now exploited is not frozen, save for occasional small patches. Water is obtained from the Pargon ditch, 18 miles long. Seven men are employed in the maintenance of the ditch system.

The elevator itself consists of a wrought-iron pipe 17 in. diam. and about 32 ft. long. At the bottom there is an aperture through which the gravel is sucked by the action of a jet of water which shoots the material to the top of the pipe, where it discharges into a line of sluice-boxes. The lower end of the elevator is called the 'throat': here the abrasion is greatest and the pipe is protected by a lining of manganese steel, leaving a



Hydraulic elevator. Ottumwa Mining Company.

passage of 10 in. diameter. The nozzle is 3½ in. From the top of the nozzle to the upcast pipe, above the throat, is 11 ft. From the nozzle to the base of the ball joint underneath is 2 ft. From the nozzle to the dump-box is 28 ft. vertical, but the elevator-pipe is set at an angle of 80°. An inclination less steep, say 60°, is deemed best for elevating, but when flat there is a tendency to deflect the gravel too far down the sluice-boxes. This can be prevented by a curved hood, for the gravel shot up the elevator impinges against a shield of manganese steel. The water issuing from the elevator-nozzle is under a head of 940 ft., and 285 miner's inches (or 427 cubic feet per minute) are used. The elevator is fed by a monitor having a 2-in. nozzle receiving water from an 8-in. pipe. Usually a $2\frac{1}{2}$ or 3-in. nozzle is used in connection with a 12 or 14-in. pipe. This monitor uses 86 miner's inches (or 129 cubic feet per minute) under a head of 240 feet.

In addition to the monitor and the elevator a water-lift is employed to pump the seepage in the excavation where this work is proceeding. This uses a $3\frac{1}{2}$-in. nozzle and 243 inches of water. In this way 250 inches of seepage water is raised about 25 ft. Thus, the water-lift raises a further amount of water equal to that required to do its duty. The hydraulic elevator that was raising the gravel was also lifting its own 86 inches of water and about 50 inches of seepage, making 136 inches or 204 cubic feet per minute. Thus, the water in the excavation totalled 336 inches, of which 86 came from the monitor and the remainder was creek-water that found its way through the sides of the pit.

The monitor drives the gravel into a trench in the bedrock provided with iron sluice-boxes 2 ft. wide lined with iron pole-riffles. These are set at a gradient of 9 in. per 12 ft. On issuing from the upper end of the elevator, the gravel is washed by the excess of water down sluice-boxes, the first of which is lined with 16-lb. rails having their base upward ; then follow slotted riffles made of white iron.

The 'piping,' or discharge of water from the monitor, illustrates the process of moving the gold with the gravel into a sluice-box, while the use of riffles illustrates the operation of arresting the gold while facilitating the escape of the gravel. In the one case there is the removal of obstructions on bedrock, a steep grade, and an excess of water ; in the other the grade is minimized, the force of the water is adjusted so as to move the gravel while dropping the gold, and obstructions are created in the form of riffles so as to trap the gold while allowing the gravel to run with the water down the sluice-boxes.

A few notes on the mode of operation will be proper. If the ground is rich, it is usual to extract all of it and to build a brush dam for restraining the tailing. If the ground is not rich, it is economical to leave a barrier of unworked gravel. It is also practicable to allow the tailing to run back against a dike of ground, this tailing becoming so packed that at the finish the remnant of gravel can be piped.

When preparing to install an elevator, the first thing is to dig a pit to receive it. The top of the ground is blown off with a nozzle, then sluice-boxes are set up, discharging their tailing into a former excavation, now worked out. The new hole is made to bedrock. Then, by shovelling or by blasting, a pit is made for the reception of the elevator. The depth required below the surface of bedrock will vary ; usually it is 8 ft. Now erect the elevator and make the necessary pipe connections. Wash the ground immediately around the elevator, gently, widening the space to 15 ft. each way from the elevator, so as to prevent the bank from caving into the pit. Next, make room for the bedrock-sluice by piping in a straight line, but using a low head, so as not to injure the elevator, which is in front. Complete the ground-sluice. Then set up your 'giant' or 'monitor' as far from the inlet of the bedrock-sluice as is practicable, that is, as far from the sluice as the rush of water from the nozzle will drive the gravel. With a 3-in. nozzle under 240-ft. head operating from a 14-in. pipe-line, that distance is 165 feet.

Begin piping into the elevator, down the bedrock-sluice. The elevator is guarded by a man who prevents the inlet from being choked by large boulders. As they are driven toward the pit, he breaks them with a 10-lb. hammer. Thus the work proceeds until the excavation has the form shown in the annexed diagram. The giant is then brought forward, the ground stripped and worked-out having been carefully cleaned and tested by panning. The giant is placed on one side and a cross-fire maintained up to the line of the bedrock-sluice. Use the little 8-in. line in order to give more water for the bedrock-sluice. Even attach a nozzle to this line and use it thus, so that there are three giants available for shifting the gravel.

The bedrock is cleaned with pick and shovel, in the usual way. This forms the larger part of the labour cost, for it requires three or four extra men. The ordinary operation is performed by one man at the monitor and one man tending the elevator-pit. The small 8-in. pipe-line is used to pump seepage by means of the water-lift, which is set at the side of the big elevator in case the latter becomes choked so as to flood the pit.

From records of the past season I obtained the following figures : In 24 hours 1070 cubic yards, from surface to bedrock, was raised by one elevator. In another instance the duty was 580 yards in 24 hours, the smaller accomplishment being due to a patch of frozen ground. Again, 804 yards was raised in 24 hours where no frost hindered. None of these performances included the cleaning of bedrock; they record the time of 'piping' only. The cleaning of bedrock takes as long as the piping, if not longer. While the clean-up is in progress, the elevator is engaged in keeping the excavation dry. In one of the most successful recent operations 11 days of piping were followed by 13 days of clean-up. The average duty ranges from a little less than one yard to 1·75, but if the time expended in cleaning bedrock be included, the duty becomes about $\frac{3}{4}$ to $\frac{7}{8}$ cubic yard. Labour and supplies range from 16 to 34 cents per cubic yard. The total cost of operating in the season of 1907 was 45 cents per yard, inclusive of all expenses.

The use of the monitor and the elevator ensures the disintegration of any clay associated with the gold. Decomposed schist, for instance, such as constitutes the top of the bedrock in many northern localities, is cut and broken by the force of the jet. Another feature is the relatively small amount of labour involved; this is an attractive argument in a region where a skilled labourer is paid, including board, from $8 to $10 per day. But the hydraulic elevator is extravagant in its use of water. In a country where the precipitation of moisture, as rain and snow, is small and where alluvial deposits are widely distributed, it seems wasteful to employ water directly to raise water. Where water is worth $1 per miner's inch per day, it seems possible to use this form of natural energy to better advantage.

In many cases it would be more economical to transform the energy of the water into electricity and transfer the power along a copper wire for use in machinery, such as the mechanical elevator or the dredge. In a country presenting unusual difficulties to the building of ditches and to the maintenance of them, it would appear cheaper to transmit power as electricity than as running water. Moreover, not many of the streams have a high snowy watershed; most of them obtain their water from the melting of the ground-ice; the creeks are largely fed by ground-water. This means that the flow decreases rapidly going up the stream and by the time a high head is available the supply of water has decreased to the point of being inefficient. A wire can be led farther and more cheaply than a ditch can be constructed. The small trees growing in the interior of Alaska will usually provide sufficient poles close to the place where they are to be erected and the climatic conditions are fully as favourable to maintenance of such a pole-line as in any other mining region. In the Yukon this idea has been already applied.

THE MUREX MAGNETIC PROCESS

THE Murex process belongs to the group of concentration processes in which the selective affinity of oil or grease for metallic surfaces is employed for the purpose of separating sulphides from non-metallic gangue. Full information relating to this action of oil was given in the article entitled 'History of the Flotation Processes,' which appeared in our last issue. Briefly, if oil is added to pulp, it immediately associates itself solely with the sulphide or metallic particles, and agglomerates them together into granules. This principle has been applied in a variety of ways, but the applications hitherto successful consist of floating the agglomerated particles by means of air or gas bubbles, which are attracted by oily metallic surfaces, but not by the gangue. The Murex process employs oil or grease for agglomerating the sulphide particles, but the method employed for removing them is entirely new. A magnetic substance, such as magnetite, is added to the pulp in small quantities. The agglomerations or granules then become a mixture of oil, magnetite, and sulphide, and it is possible to lift them out of the pulp by means of an electro-magnet, the attraction of the magnetite being sufficient to carry with it the non-magnetic particles held to it by the oil. In carrying out the process the magnetic material is first thoroughly incorporated with the oil or grease; this incorporation cannot be effected without the use of a substance that creates a chemical reaction between the oil and the magnetic material. The particular salt used for this purpose cannot be mentioned on account of pending patents.

By means of this process substances such as galena, blende, and pyrite can be magnetically concentrated from their ores. In the case of galena and blende, magnetite is used as the added magnetic mineral, but in dealing with chalcopyrite or other copper sulphides, it is preferable to roast a part of the concentrate and use the magnetic material thus obtained. The plant employed resembles the Wetherill magnetic concentrator. The crushed ore and water are fed into a mixer into which the emulsion of oil and magnetic mineral is introduced, to be incorporated with the pulp. It is found that the sulphides and magnetic mineral are agglomerated into granules by the oil. The granules are not as large as those agglomerated with oil and gas bubbles, which is probably an advantage, as less gangue will be intermixed with them. The pulp is carried from the mixer along a Zimmer shaking conveyor together with a free supply of water underneath a cross-travelling belt of the magnetic concentrator. The agglomerated granules are attracted to the belt and carried away, while the gangue is discharged from the end of the conveyor.

Several points in connection with the action of this plant are noteworthy: No acid is used in mixing the oil with the ore. It is commonly urged that acid in the water assists the selective action of the oil and where flotation accompanies agglomeration the acid is required for generating the buoying bubbles. In the Murex process, however, the principle of flotation is not employed, and, in fact, it is to be carefully avoided, because if the particles float down the conveyor on the surface of the stream of water the surface tension of the water prevents the particles from answering the call of the magnet. It is necessary that the particles shall be below the surface and in frictional contact with the bottom of the conveyor. Their sudden flight upward on coming into the field of the magnet enables them to pierce the surface of the water without being held back by the surface tension. Another reason for not using acid is that when an ore has a large amount of calcite or limestone gangue the acid is immediately neutralized. In parenthesis, we may interpolate the remark that excess of calcite gangue is a frequent cause of the failure of the flotation processes. If copper ores are being treated this ends the process, but if magnetite has been used or if it is intended subsequently to separate the constituents of the concentrate, it becomes necessary to de-oil the concentrate, and then pass it in the wet state under another magnet with a weak field in order to recover the magnetite.

The amount of oil and magnetic mineral to be used varies with the amount of sulphide in the ore. With Broken Hill ores, which contain 40% sulphide, 60 lb. magnetite and 20 lb. black fuel-oil are added for every ton of ore; but an average copper ore contains less sulphide than this and would require less oil, and only a small quantity of magnetized sulphide.

The use of a magnetic mineral such as magnetite might be supposed to constitute an unwarrantable expense, but as the second magnet removes practically the whole of it from the concentrate the actual consumption must be insignificant.

Another item of cost on which definite information is to hand relates to the amount of current used in the magnets. In the experimental plant, now treating Broken Hill ore, the magnet consumes approximately one horse-power, and one ton passes through in an hour. When treating copper ore about double that quantity can be treated in an hour. The plant is simple to make and to erect; it occupies very little room and does not require specially designed buildings. The width of the belt of the magnetic concentrator working on Broken Hill ore is 15 inches, a figure that gives an idea of the general dimensions of the plant.

The Murex process also includes another and quite distinct invention, namely, the application of sodium silicate for disassociating the mixed galena and blende, such as is found at Broken Hill. In practice where the silicate of soda is made on the spot by first acting on the carbonate with lime and then treating silica with the caustic soda so formed, the actual solution used will be a mixture of caustic soda and sodium silicate. The amount used in treating a ton of zinc-lead sulphide containing no gangue is approximately 28 lb. of 20% solution which costs about one shilling. Twenty minutes of agitation, with ore crushed to 40 mesh, will effect a separation sufficiently complete to enable the material to be treated on Wilfley tables without the production of any middling.

The two Murex processes make it possible to treat Broken Hill ore in a way quite different from that ruling at present. At the experimental works, the raw ore, containing 40% mixed sulphides, is passed through the magnetic machine. Approximately 5 to 7% of gangue goes over with the concentrate and about 5% sulphides passes away in the tailing. The oil is then burnt out and the magnetite removed by the second magnet. The concentrate is sized to 40, 60, and 80 mesh, and passed over Wilfley tables. Not much slime is made, the amount going through the 80-mesh screen being as a rule less than 5% of the whole ore. The tables produce lead and zinc concentrates assaying respectively, 75% lead and 3 to 5% zinc, and 45% zinc and 3 to 5% lead. The line of demarcation between the two concentrates is well defined and usually no middling is formed. The table treating the 80-mesh material is arranged in such a way that the slime passes down the table with the water. This slime assays 21% lead, 22% zinc, and 45 oz. silver. The practice is to add the slime to the lead concentrate, and thus the silver is saved while not raising the zinc content so as to affect the value of the concentrate. It will be seen that by this process practically all the contents are recovered and in that way it compares favourably with the present practice, which consists of jigging for lead concentrate, re-crushing the tailing, and extracting a zinc concentrate by flotation, with a subsequent separation of the lead content from the zinc concentrate on tables. In addition to the tailing treated for its zinc content there are at Broken Hill enormous quantities of rich slime that cannot at present be treated. In this series of processes it is necessary to crush fine so as to get a mechanical separation between the two sulphides, and also to have the zinc tailing fine enough for the heavy mineral to be raised by flotation. It is open to question as to how far the flotation processes are applicable to heavy minerals like galena, for they require such fine grinding as to entail a large amount of slime. In a flotation process it is, from one point of view, desirable to crush finely; but on the other hand, if the ore is slimed the gangue is slimed as well, and then it will not settle by gravity and cannot be separated from the sulphides. Thus the flotation processes are useless with slime and with ore containing friable gangue. The Murex process does not depend on flotation, and friable copper ores with friable gangue present no sliming difficulty, while with Broken Hill sulphides the slime question does not count because practically no slime would be formed.

The scope for the new process seems to be where water concentration and flotation processes fail. As regards the first point it would be applicable to low-grade copper ores from which only 70% is recovered by the tables. Probably flotation processes would be cheaper than the Murex wherever the ore is amenable, but the range of ores suitable for treatment by flotation is limited. It is as yet too soon to estimate the cost and range of application of the Murex process, but evidently it is a method that the metallurgist cannot afford to ignore.

The process was invented by A. A. Lockwood and has been developed entirely in England.

PERSONAL

W. K. BETTY, from Johannesburg, has been motoring in England; he is now in Michigan.

F. L. BOSQUI and A. H. ACKERMANN sailed for Cape Town, on their way to Johannesburg, on September 11.

WALTER BROADBRIDGE sailed for West Africa on September 25.

F. W. BRADLEY has returned to San Francisco from Treadwell, Alaska.

CHARLES BUTTERS sailed for New York on September 25.

GELASIO CAETANI has been visiting the mines of the Cleveland Cliffs Iron Co., in Michigan.

RICHARD E. CARR, consul at Cordoba, Spain, was in London recently.

H. COLLBRAN is in London on a visit from Korea.

C. L. CONSTANT, WALTER H. WEED, R. B. LAMB, and FRANK H. PROBERT have joined forces under the name of the C. L. Constant Co., New York.

J. H. CURLE is in the Caucasus.

H. S. DENNY, who now resides in Mexico, is in London.

FRANK ELMORE is at Broken Hill.

JOHN B. FARISH has returned from Mexico to Denver.

ROWLAND FEILDING has returned from Siberia.

E. NELSON FELL has returned from a visit to Virginia, U.S.

W. R. FELDTMANN went to West Africa on September 25.

F. G. GRAHAM has recently returned from Bolivia.

F. O. HARVEY returned recently for a tour of inspection in Spain.

ROBERT HAWXHURST has resigned as manager of the Poderosa mine, in Chile, and is expected in London.

CHARLES S. HERZIG returned on October 2 to Nicaragua, by way of New York.

H. C. HOOVER has returned from a flying trip to New York.

E. S. KING has been appointed manager for the Gwalia Consolidated in Western Australia.

T. BRUCE MARRIOTT has returned from West Africa.

H. W. MUSSEN has been appointed assistant superintendent for the Orsk Goldfields, in Siberia.

EDWARD H. NUTTER has returned from Alaska to South Africa.

R. E. PALMER, mining engineer to the Rio Tinto Company, was in London during September.

ARTHUR L. PEARSE, of Pearse, Kingston & Browne, sailed on October 6 for the United States.

H. A. PIPER, consulting engineer in Rhodesia to the Consolidated Gold Fields of South Africa, is in London.

FRANK PROBERT goes shortly to Guanajuato, Mexico.

N. SAMWELL is returning from Rangoon to England. On his way he is visiting the dredging districts of California.

ERNEST W. SPENCER, manager for the Consolidated Goldfields of New Zealand, at Reefton, was in London during September.

W. F. A. THOMAE was in Portugal recently.

WALTER H. WEED was in Arizona during September, and is now at Butte, Montana.

H. E. WEST is on his way back to El Oro, Mexico.

WALTER WETHERED has gone to Nigeria, to take change of tin mines near Bouchi.

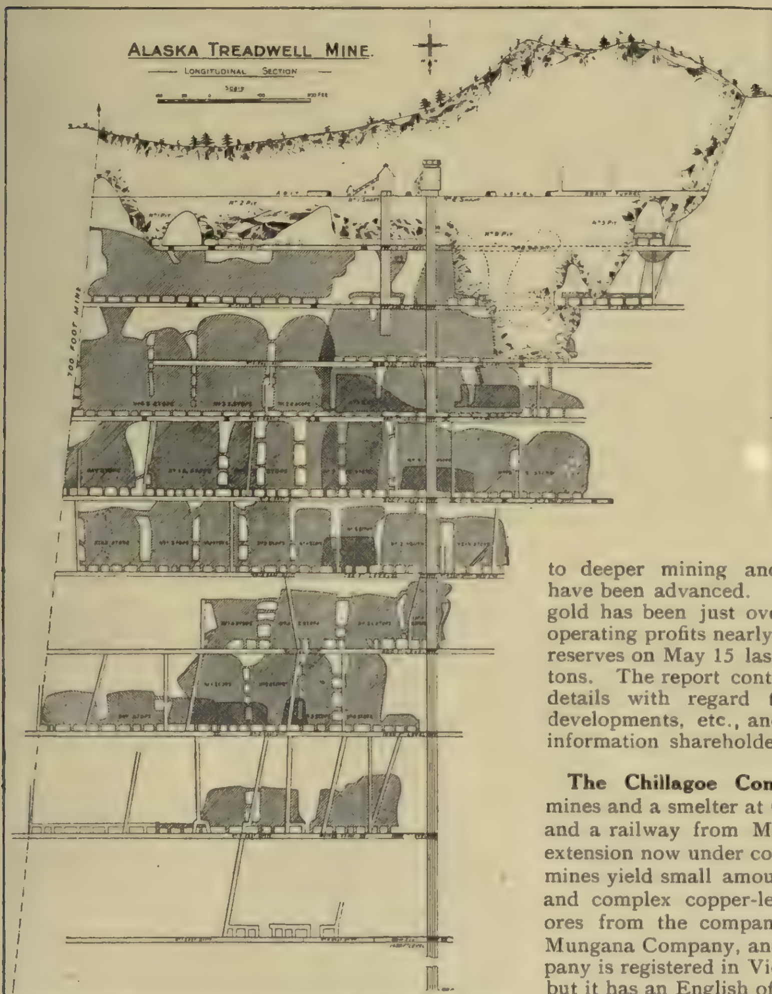
A. G. B. WILBRAHAM sailed for South Africa on October 9, and will be in Rhodesia for several months.

C. W. WRIGHT is consulting engineer to the Societa di Pertusola, in Sardinia.

AMONG THE MINING GEOLOGISTS engaged as expert witnesses in the case between the Bunker Hill & Sullivan Mining Co. and the Federal Mining & Smelting Co., at Wardner, Idaho, are A. C. LAWSON, ALBERT BURCH, J. R. FINLAY, R. D. GEORGE, T. SIMONS, ROBERT N. BELL, and POPE YEATMAN on one side, and JAMES F. KEMP, HORACE V. WINCHELL, and JOHN W. FINCH on the other.

COMPANY REPORTS

Alaska Treadwell Gold Mining Co.—This company has issued its nineteenth annual report, covering the year ended May 15, 1909. The mines are on Douglas island, Alaska, and the head office is at San Francisco. There are many shareholders in England and France, and their interests are represented by the Exploration Company and the Compagnie Française de Mines D'Or et de l'Afrique du Sud. Robert A. Kinzie is the superintendent and F. W. Bradley is consulting engineer. During the year in question 768,628 tons went through the mill and yielded gold valued at $912,427. In addition 14,326 tons of sulphide concentrate were shipped to the Tacoma smelter and yielded gold valued at $790,200, making a total of $1,702,627. The average yield was therefore $2·215 per ton. The operating costs were as follows: Mining, including development, $873,287 (or $1·136 per ton); milling $139,607 (or 18 cents per ton); cost of treating sulphides $94,869 (or 12 c. per ton); general expenses at the mine $54,699 (or 7 c. per ton); construction and repairs $33,756 (or 4 c. per ton); and other sundry small items, bringing the total operating and construction costs to $1,218,445 (or $1·585 per ton). To the income from the gold extracted, there are to be added commercial profits, $79,394 and interest on deposits, $9413, making a total income of $1,791,436 (or $2·33 per ton), leaving a net profit of $572,991 for the year (or 74½ cents per ton). Out of this profit $550,000 has been distributed as dividend, being at the rate of 11% on the par value of the shares. The average quotation of the $25 (or £5) share in London is £7, so that holders obtain about 8% on their money.



This mine was originally known as the 'Paris' and was first opened up in 1882. From that year until May 1890, the production was $2,328,496 from 617,112 tons of ore, or an average yield of $3·79, at a cost of $2·05. In the latter year the present company took over the property. The number of stamps was increased from 240 to 540 in 1899, and in the same year the chlorination of the sulphides on the spot was abandoned, the present system of shipping to Tacoma being then started. In 1900-'02, the average yield fell to below two dollars per ton, and during the financial year 1899-1900 the costs fell below one dollar, being only 86 cents. During the last five or six years the yield has remained fairly constant, but owing to deeper mining and increased wages the costs have been advanced. Since 1882, the total yield of gold has been just over 24 million dollars and the operating profits nearly 11 million dollars. The ore reserves on May 15 last were estimated at 5,806,792 tons. The report contains over 90 quarto pages of details with regard to the administration, costs, developments, etc., and is a model of the kind of information shareholders are entitled to receive.

The Chillagoe Company.—This company owns mines and a smelter at Chillagoe, North Queensland, and a railway from Mareeba to Chillagoe with an extension now under construction to Etheridge. The mines yield small amounts of low-grade copper ores and complex copper-lead ores; the smelter treats ores from the company's mine, from those of the Mungana Company, and from elsewhere. The company is registered in Victoria and is controlled there, but it has an English office also. Mining and smelting difficulties have prevented the operations being conducted at a profit, and the company has been reconstructed several times. E. J. J. Rodda is mine manager and J. Horsburgh is metallurgist, while E. A. Weinberg is consulting engineer. The report, for the year ended March 31, shows that the company's mines are not profitable. From the Ruddygore mine 10,505 tons, containing 304 tons of copper and 12,121 oz. silver, were broken and shipped to the smelter and the Redcap group yielded a small amount. In addition, old slags and dump ores from the Calcifer and Boomerang mines were sent to the smelter to supply metal-bearing fluxes in place of barren ironstone and limestone. The total amount shipped to the smelter from all the company's mines and roasting heaps was 18,305 tons containing 554 tons of copper, 80 tons of lead, and 29,322 oz. silver. The bulk of the ore treated at the smelter came from the Mungana mine, which belongs to the Mungana (Chillagoe) Mining Co., in which the Chillagoe company owns a financial interest. The amount of Mungana ore treated was 44,469 tons and other purchased ores 4381 tons; in addition, some flux ores were purchased. The Mungana contribution is a complex lead-copper ore requiring special treatment; some is sent direct to the lead smelting furnaces while the remainder is preliminarily roasted in Edwards furnaces and a Huntington-Heberlein plant. The lead smelters produced 6841 tons of lead and 442,987 oz. silver. The lead-copper matte produced amounted to 7721 tons and contained 1597 tons of copper and 174,167 oz. silver. It was sent to the company's copper furnace for concentration along with silicious ores from the company's ore from the Ruddygore mine. The high-grade mattes thus produced were afterward treated in converters, where blister copper was produced containing 3031 tons of copper, 354,694 oz. silver, and 159 oz. gold. The slags from the converter are sent back to the lead furnace, as they contain much lead and copper. The company reports that within a short time additional supplies of copper ore will come from the Einasleigh district. As regards the railway, this provides the chief source of income, the profit on the year's working being £78,000, which constitutes the bulk of the profit of £94,507 earned for the year. Out of this £24,915 is paid as debenture interest, £49,563 is written off for depreciation and mine development, and £10,454 is appropriated to various charges, so that the balance to be carried forward is reduced to £9625.

Mungana (Chillagoe) Mining Co.—This company is under the same control as the Chillagoe Company which owns part of the shares and treats the ores produced. The report now presented covers the nine months ended March 31, the date of the making up of the accounts having been changed from June 30 in order to coincide with that of the Chillagoe Company. The total amount shipped during the nine months was 37,231 dry tons, of which 19,301 tons came from the Lady Jane mine, 15,301 tons from the Girofla, and 2629 tons from the roast heaps. The total contents were 1537 tons of copper, 6499 tons of lead, and 469,109 oz. silver. The ores are mixed lead and copper ores which present a special problem in smelting and the prices realized are not high. Since the inception of the company in 1902 the ore sent to the smelters has averaged 5·54% copper, 13·4% of lead, and 12 oz. of silver. The mining costs during the nine months covered by the report were £33,363, and the mine development charge £3875; other expenses came to £6081. The receipts from the sale of ore were £44,067 and other receipts £364. The net profit was therefore £1111.

Heawood Tin & Rubber Estate.—This company has been formed to acquire the properties of the Heawood Syndicate, situated in the district of Kuala Kangsar, twenty miles from Ipoh, Federated Malay States. The reports upon the tin ground were made by R. C. Corbett, George Ritchie, and A. L. Lewis. Part of the area is stated to be suitable for hydraulic working on a large scale; at present it is being exploited by Chinese tributors. In another part of the property a tin outcrop of promise has been found. Very little information is given in the prospectus with regard to the tin deposits, and no scheme is outlined for dealing with them. The capital of the company is £64,000, of which 31,400 shares of £1 each go as purchase price and 32,600 shares are offered for subscription. The offices of the company are at Glasgow.

Consolidated Gold Fields of New Zealand.—This company operates the Wealth of Nations mine at Reefton, N.Z., and owns the Humphrey's Gully and Golden Fleece properties, which are now worked by tributors. Furthermore, the company has a large interest in the Progress and Blackwater mines (see below) which it floated as separate undertakings. It was David Ziman who introduced these properties in England in 1896. Ernest W. Spencer is the resident general manager for the whole group of mines. The Wealth of Nations is a small mine, but yields a satisfactory profit, though not commensurate with the large capital of the company. During 1908, the tonnage stamped was 13,479, and the yield by amalgamation was valued at £17,725. In addition, the cyaniding of 11,920 tons of tailing yielded £8357; cyanide slags and sulphides, £1026; bringing the total income to £27,108. The costs at the mine were £12,652, leaving a profit of £14,455. Improvements have recently been introduced whereby increased pressure is obtained for hydraulically operating the power plant, and a tube-mill and additional cyanide plant have been provided. The Golden Fleece was worked for part of the year at a loss, and was subsequently let on tribute. Humphrey's Gully, a gravel property, gave equally poor returns. The company's profit and loss account shows total mining expenses £15,697; provision for depreciation and development, £3372; and London office expenses, £2220. On the credit side, gold recovered by mining and received from tributors was valued at £30,218; while dividends yielded £937 and realization of investments, £4092. Out of the available balance of profit, £12,118 was distributed as dividend, which is at the rate of 5% on the issued capital £242,378. The company since its inception has paid dividends amounting altogether to 14s. 6d. per £1 share. Dividends in 1899 and for four years after were at the rate of 10%. On one occasion the rate was 7½%, but since then the return has been regularly 5 per cent.

Progress Mines of New Zealand.—This company is a subsidiary of the Consolidated Gold Fields of New Zealand, mentioned above, and was floated in 1896. According to the report for 1908, just issued, it appears that the output of the mine was not equal to the capacity of the mill, and at times it was not possible to employ more than 40 out of the 65 stamps. The tonnage crushed was 48,500, yielding 11,837 oz. bullion valued at £48,754. In addition, 33,300 tons of sand, representing 68% of the tailing from the battery, was cyanided and yielded bullion valued at £9544. Concentrate to the value of £2947 was sold, while the remainder, valued at £2874, was stacked for local treatment in the future. Experimental work was continued with a view to discovering some suitable treatment for the slime, but no satisfactory results were obtained, and the slime is now being stored. It has been decided to erect a smelter for the purpose of treating the pyritic concentrate, slime, and the chlorination residues. The old chlorination works have therefore been demolished and the space is being utilized for the erection of roasting and smelting furnaces. As the ore contains arsenic, condensing chambers are also being provided. Development work has been disappointing, the greater part of the ore discovered having proved poor. The working costs at the mine were £48,927; general expenses in London and New Zealand, £4684; taxes, £4626; depreciation, £3542; development account, £3091.

COLOMBIA

The Oroville Dredging Co.'s new property is near Zaragoza, in the State of Medellin.

On the credit side the chief items are bullion, £60,985; interest and profit on realization of investments, £10,383. A net profit of £6556 was made, and it will be seen that this was not provided by the mine itself. The decrease in the yield from the ore during the last year has been considerable, the product for 1908 being 25s. 3d. per ton, as compared with 35s. 1d. during 1907. The capital of the company is £275,000. Dividends commenced in 1899 and continued until 1907, the total distribution during that period being 23s. 6d. on each £1 share.

Oroville Dredging.—This company was originally formed in America in 1905 to consolidate the interests of four Californian dredging companies. The shares were extensively bought in England; sufficient, indeed, to secure the control on this side. In order to bring the direction of affairs more into the hands of the majority of the shareholders, an English company was formed this spring, and English shares were exchanged for the American shares. The control of the new company is in the hands of the London Venture Corporation. W. P. Hammon is the general manager in California. The statutory meeting of the new company was held last month, when the present position and the prospects were fully explained. The report of the American company for the year ended July 31, 1908, was circulated a few days before the meeting, and we would take this opportunity of pointing out that this habitual delay in issuing information has had not a little to do with the comparative unpopularity of the shares. The advantages of having a valuable property and an unrivalled engineer have been largely negatived by the action of the American directors in holding over the publication of results. In the future this objectionable feature will disappear and shareholders will receive the yearly reports at a much earlier date.

Dealing first with the belated report for the year July 1907–'08, we find that during the year 7,321,224 cubic yards were treated, and gold worth $816,929 recovered, while the expenses were $492,137. One of the properties, the Bear River, made a loss of $17,000 during the year. The company's machine-shop, at which dredges are made and repaired for other customers as well as the company itself, suffered from a fire during the year, and the profits therefrom, usually large, were practically wiped out. Also during the year three of the older dredges were abandoned, thus reducing the equipment to nine. It will be seen therefore that the profits have been rather less than usual, and $24,000 had to be drawn from the reserve fund in order to maintain the 10% dividend (on the capital of 3½ million dollars) to which shareholders are accustomed. Of the nine dredges now at work, four have 7 cu. ft. buckets, two have 5 cu. ft. buckets, one is a remodeled old type with 4 cu. ft. buckets, and two are old type with 3 cu. ft. buckets. The three discarded dredges were similar to those last mentioned. The directors are now considering the question of building two new dredges with 13 cu. ft. buckets, which will each cost $200,000. Before definitely deciding, the results obtained by dredges of this capacity working on an adjoining property are being awaited. The average extraction with the present equipment is 11·16 cents per cubic yard, while the cost is 6·72 cents, and it is claimed that with a 13 cu. ft. bucket the cost might be reduced to 3 cents. If such an economy can be effected it will be highly advantageous to spend the extra money on new dredges, for the outlay would be recouped in 18 months, and it is estimated that the life of the properties is nearly 14 years.

We turn now to the new properties to be acquired in Colombia. These are on the Nichi river, 6 miles above the town of Zaragoza, and cover an area of 22,000 acres. So far, 310 acres have been proved by drilling, and ground containing 13,000,000 cu. yd. averaging 31 cents has been proved. It is estimated that the costs will be higher than in California owing chiefly to the poorer quality of labour, and 8 cents is given as the probable figure. The property is held by the Pato Mines Co., registered under the laws of West Virginia, and 75% of the stock is being acquired by the Oroville Dredging. In order to provide working capital, debentures for £62,500 carrying 8% interest are to be created, and the whole issue has already been underwritten. It will be seen that if all the facts are as stated, the shares, which are quoted now on the Stock Exchange at 12s. 6d., are not fully appreciated.

Brazilian Golden Hill.—This company is a subsidiary to the Brazilian Goldfields, which was formed last year for the purpose of developing mines in the state of Rio Grande do Sul, Brazil. The properties acquired consist of the Cerrito Hill and Golden Hill. The capital of the new company is £150,000, of which £59,993 in shares and £3,500 in cash goes as purchase price to the parent company, and 40,000 £1 shares are now being offered for subscription. This issue of shares has been underwritten by a firm of stockbrokers, so the flotation of the company is assured. The properties were examined by André Griffiths and E. A. Mannheim, while the development work has been done under the direction of Mr. Mannheim. The Cerrito immediately adjoins the property of a Belgian company, La Société des Mines d'Or de Cerrito, which has been successful in opening up old workings. Mr. Mannheim's exploratory work has proved the existence of several gold-bearing veins, but their thickness and extent have not as yet been proved; hence no ore reserves are mentioned. However, the promoters consider that they are justified in spending £30,000 and erecting a 25-stamp mill.

Blackwater Mines.—This company is the most recent flotation of the Consolidated Gold Fields of New Zealand. It was formed at the end of 1906, milling being commenced in August 1908. The report and balance sheet now issued cover the year ended December 31, 1908, but some additional details of work up to July 31 are also furnished. During the months August to December 1908, the mill crushed 9169 tons and produced 4247 oz. bullion valued at £16,552. In addition 5055 tons of sand was cyanided and yielded 432 oz. bullion valued at £1094, making a total yield valued at £17,647. This was an extraction of £1. 18s. per ton. The total working expenses at the mine and in London were £11,486. The profit and loss account includes items of £1041 for depreciation of plant, £5000 for development, and £1,530 for rates and taxes. There are other small items in the account, and an adverse balance of £1321 is left to be carried to the balance sheet. During the first seven months of the year 1909, the ore milled amounted to 14,440 tons, for a yield of £33,457, while the working costs and allowance for development were £14,453. From the balance there will be deducted several charges, such as London expenses and depreciation, but it is clear that a fairly satisfactory profit will be shown. The slime plant has been built and should now be in operation. The developments at the mine are most promising. The ore reserves at the end of 1908 were estimated to be sufficient to keep the 30-stamp mill going for 2½ years and since that date they have been largely increased. The mine seems destined to compensate for the dwindling returns from the Wealth of Nations and the Progress mines.

Eldorado Banket Gold Mining.—This company was formed in 1906 by the Rhodesian Exploration & Development Co., to work the Eldorado mine in the Lomagunda district of Rhodesia. The consulting engineers are H. E. Jones and T. J. Britten, and H. Stephan is manager. Milling with 20 stamps and a cyanide plant commenced in September 1907, and Chilian mills were added a year later. The report now issued covers the year ended March 31 last. From this it will be seen that during the 12 months 56,241 tons were crushed yielding 25,798 oz. by amalgamation and 3986 oz. by cyanide, a total of 29,737 oz. which sold for £125,955. The working costs at the mine were £62,300, administration expenses £4535, and £9888 was written off for depreciation. The profit available for distribution was £46,925. Since the books were made up on March 31, the estimated profits to the end of August were £43,122. The first dividend paid by the company was £25,000, at the rate of 10% on the capital of the company, £250,000, and it was distributed in January 1909. Two other similar amounts were distributed on April 24 and August 11 respectively. The mine continues to open up in a satisfactory manner. On the fourth and fifth levels large bodies of good ore have been found. The main shaft is now down to 800 ft., and a sixth level will be driven at 811 ft. The eastern extension shaft, situated 2700 ft. from the main shaft, is down 100 ft., and the sinking of the new main shaft has begun. At various points the veins are rich, one assay giving as much as 18 oz. over a width of 6 ft. The milling returns show that the average extraction is 12 dwt., but judging by the figures given in the report relating to recent developments, we shall expect the yield to increase.

Globe and Phœnix.—The interim report for the half-year January to June 1909, has just been issued. It is obvious from its contents that the comment in our last issue was scarcely justified, as the discovery of the reef under the dike was made known by the directors as early as April and confirmed when results ensued. The company was formed in 1895 to acquire the Globe and Phœnix mines, 140 miles north of Bulawayo, Rhodesia. Milling commenced in 1900 with 40 stamps; a cyanide plant started work in 1901, and a slime plant in 1907. The Globe mine is closed down and for several years the Phœnix has been the mainstay of the company. From the commencement up to the end of 1908, dividends amounting in all to £1 14s. 6d. per £1 share, on a capital of £200,000, have been paid, but it must not be forgotten that in 1895, 50,000 of the shares were issued at £2 and in 1899 and again in 1902 new issues were made at £4 each. These facts make a considerable difference when figuring out the return on money invested in shares. The company has for chairman T. B.

Reynolds; the consulting engineers are H. A. Piper and A. J. Fraser, while Theodore Haddon is general manager. The report of the directors now issued is dated September 15 and that of Mr. Piper September 9. The important information contained in these reports is the finding of the vein in place below the dike which had threatened to end the life of the mine. Furthermore, the veins have widened and the newly developed parts are of much higher content. At various points substantial bodies of ore averaging 44 dwt. and 52 dwt. have been developed and the estimated ore reserves on June 30 are given as 168,984 tons containing 22 dwt., an average which is 6 dwt. higher than the reserves as estimated six months ago. During the six months reviewed, the 40-stamp mill crushed 35,051 tons and extracted 24,986 fine oz., or 13·22 dwt. per ton. The mill-feed assayed 20·63 dwt. and the tailing 6·04 dwt. The cyanide plant treated 20,364 tons of sand having an assay value of 5·91 dwt. The extraction was 1928 oz., or 2·15 dwt., leaving 3·76 dwt. in the residue. The slime-plant treated 11,783 tons of accumulated slime assaying 2·5 dwt., leaving 0·45 dwt. in the residue; and 2780 tons of current slime assaying 5·82 dwt. and leaving 3·82 dwt. in the residue. The total recovery in the slime-plant was 1322 oz. The reason for the poor extraction is the presence of antimony in the ore. For some time experiments have been conducted for the purpose of evolving a new process and the advice of H. T. Brett has been taken. Mr. Brett's recommendations are endorsed by Mr. Piper, but they are not published in the report, which is a pity, seeing that information about the treatment of antimonial gold ores is always useful to metallurgists.

Broken Hill South Silver Mining.—This company is controlled locally and the manager is W. E. Wainwright. The mine is situated north of South Blocks and between the two parts of the property of the Sulphide Corporation. The report for the half-year, January to June, shows that the mine is doing well in spite of the low price of metals. The amount of ore raised was the greatest of any half-yearly output during the 16 years of the mine, namely, 137,848 tons, as compared with 112,288 tons during the previous half-year. The assay of the ore raised was 14·9% lead, 12·1% zinc, and 5½ oz. silver. From this ore was produced 20,746 tons of lead concentrate, assaying 73·6% lead, 4½% zinc, and 19·3 oz. silver; also 41,563 tons of zinc tailing, assaying 4% lead, 18·7% zinc, and 3·4 oz. silver; also 58,368 tons of quartz tailing, assaying 2½% lead, 10% zinc, and 2 oz silver; also 17,162 tons of slime, assaying 12·7% lead, 12% zinc, and 5·7 oz. silver. Owing to the limited demand for lead concentrate in the early part of 1909, the concentrating mill did not run at its full capacity, but toward June the output was raised to over 1000 tons per week. The whole output of lead concentrate for the remainder of 1909 has already been sold and negotiations are pending for the disposal of a large part of the product for a number of years. As regards the disposal of the zinc tailing, some of this material is already being sold to the Zinc Corporation. Recently additional contracts were made with the De Bavay's Treatment Co., whereby some of the tailing will be supplied at 3s. 9d. per ton to be treated by the present plant, and a further supply treated by the new plant for a period of seven years. The price to be paid for the latter is 3s. 6d. per ton on delivery, and after another 3s. 6d. has been credited to the De Bavay Co., the remaining profit is to be divided equally between the two companies. In spite of adverse circumstances ruling at Broken Hill, the working costs have been still further lowered: mining costs were 9s. 2½d. per ton, development 9d., and concentration 3s. 11d. The income from the sale of lead concentrate was £155,922, and receipts from the Zinc Corporation £4032, making a total of £159,954. The mine cost totalled £109,441, leaving £50,513 to go to profit and loss account. General administration, office expenses, and taxes absorb £3900, and £10,742 has been written off for depreciation. Dividends amounting to £40,000 were distributed, which is at the rate of 48% per annum on the paid up capital of £163,508. The ore reserves are estimated at 3½ million tons above the 970-ft. level, which level continues to open up in a satisfactory manner; in addition, the company has 1½ million tons of zinc tailing and slime stacked on the surface. The prospects of this company are decidedly cheerful.

North Broken Hill.—This company has done remarkably well during a period of depression and the outlook as regards both ore reserves and improved metallurgical treatment is bright. The control is local, with George Weir as manager. According to the report for the half-year ended June 30, just issued, 66,797 tons of ore were treated, averaging 15·9% lead, 7 oz. silver, and 14·3% zinc. The yield of lead concentrate was 11,372 tons, assaying 70·87% lead, 21·83% oz. silver, and 6·61% zinc. The recovery was 75·38% of the lead and 53·63% of the silver. In addition 33,842 tons of zinc tailing, averaging 19·9% zinc, 3·9 oz. silver and 4·2% lead was produced, together with some slime and barren tailing. The whole of the zinc tailing has been delivered to the De Bavay's Treatment Co. A new mill is in course of erection and will be completed toward the close of the year. This mill will treat 5000 tons of crude ore per week and the output will therefore be greatly increased. With regard to the ore reserves, no definite figures are given, but the mine is opening up well at all levels as far as has yet been sunk, namely 1130 ft. The whole of the output of lead concentrate has been sold up to the end of 1914. The working costs during the half-year in question were: Mining, 9s. 11½d. per ton; milling, 3s. 6¾d.; development, 1s. 7½d.; or a total of 15s. 1¾d. per ton. The profit and loss account shows receipts of £82,765 from lead concentrate and zinc tailing, working expenses £51,559, administration and taxes £2717, dividend £14,000 (at the rate of 20% per annum on the capital of £140,000), and written off, £13,095.

Great Fitzroy Mines.—This company is registered under the laws of the state of Victoria, and owns copper mines 16 miles north of Rockhampton, Queensland. It was formed in July 1908 as a reconstruction of a company of similar name which had commenced the development of the mine and provided a smelter capable of producing 900 tons of copper a year. The general managers are Bewick, Moreing & Co., and the directors include such well known names as H. C. Hoover, W. J. Loring, W. L. Baillieu, G. P. Doolette, Philip Charley, and W. S. Robinson. D. E. Bigelow is mine superintendent. Work is being concentrated on development; the results may be seen from the fact that during the year ended June 30 the ore reserves have been increased from 334,000 to 981,000 tons, assaying 3¼% copper, 2·66 dwt. gold, and 1 oz. silver per ton. During the current year further development will be done and the extent of the orebody at the 400 ft. level thoroughly ascertained. With the old metallurgical plant 34,261 tons were smelted during the year and matte produced containing 980 tons copper, 5990 oz. gold, and 32,499 oz. silver. Additional concentrating and smelting plant is in course of erection and will shortly bring the monthly total to 18,000 tons of ore. The capital of the company is £500,000 in £1 shares. Of these 375,000 were issued in exchange for the shares in the old company, and on the 2s. liability being paid up the company obtained £37,500 working capital. In May of this year another block of 25,000 shares was issued. It is as yet too early to go into the costs and expenditures; all that need be said is that the mine is an unusually promising investment.

Tyee Copper.—For a number of years this company operated the Tyee copper mine on Vancouver Island. At first the ores were shipped to Tacoma, then a smelter was erected and the matte sent away for treatment, and finally a complete treatment plant was provided. The mine is now exhausted and the company has had to fall back on custom work to keep the smelter going. Some money has also been spent in investigating other properties, but so far without success. The largest shareholdings are in the hands of the Siemens group. The report for the year ended April 30 shows that the work of transforming the plant at Ladysmith into a custom smelter has been very difficult, and the struggle for regular supplies of ore in competition with other firms in the same line has been severe. An additional furnace has just been completed, and this and the old one together are capable of treating 12,000 tons of ore per month. During the year under review the new furnace had not started work, and the old one was only employed for seven months owing to scarcity of ore. Consequently, no profit was made by the smelting operations and the necessary allowances for depreciation, cost of exploration work on new properties, and other charges, made an adverse balance of £22,646. There is a reserve fund invested in Government securities amounting to £68,718, and the finances are carefully managed, so that the company is in as satisfactory a condition as is possible under the circumstances. Seeing that the business of the company has been changed from mining to custom smelting, the directors, very properly, have abridged their published accounts. There are times when the healthy practice of taking shareholders into their confidence can no longer be safely followed by directors, and in the present case it was felt that the details relating to ores purchased, such as the price paid, their source, and the working expenses, should not be divulged. At the general meeting there was some opposition on the part of a few shareholders to this policy of silence, but eventually most of the critics were convinced that the directors were acting in their interest.

Selukwe Gold Mining.—The report of this company for the year ended March 31 shows that the mine has arrived at a critical stage in its history. The mine is situated 120 miles northeast of Bulawayo and operations commenced in 1898. During the whole time W. G. Greene has been manager, and he is now retiring owing to ill-health, H. Wylie succeeding him. Franklin White is consulting engineer and the company belongs to the Bechuanaland Exploration group. The capital of the company is £321,000, and the only dividends paid have been three of 10% each distributed in August 1902 and February and August 1903. Some of the shares were issued at a substantial premium. For the last few years losses have been made. The report for the 12 months now issued shows a further loss. Forty stamps crushed 61,392 tons and yielded over the plates 11,799 fine oz. The cyanide plant treated 41,618 tons and produced 3050 fine oz. Together with 31 oz. recovered in concentrates, the total yield was 14,881 oz., which sold for £63,357. It will be seen that the yield by amalgamation was 3·84 dwts. and by cyaniding 1·46 dwt. per ton. The costs of mining, milling, and cyaniding were £62,969; but in addition to this the costs were increased by £13,223 for development and repairs and 17,004 for depreciation. The debit balance for the year's work without taking into account any London expenditure is £29,000. During the year previous the loss was £13,000 and the year before that £28,647. The financial position of the company is therefore serious. The outlook at the mine is far from encouraging. As the developments did not disclose any payable ore the directors acquired adjoining claims containing the Nigger Reef, but this also is proving to be equally unsatisfactory. The amount of ore exposed is about 60,000 tons, but only a quarter of this is payable. The engineer's estimate is that 15,291 tons in a vein 30 inches wide averaging 8·63 dwts. are payable, while 102,113 tons are also developed but will not pay for extraction. Under these unfavourable circumstances the directors have requisitioned further expert advice.

El Oro Mining and Railway.—The report for the year ended June 30 has just been published. This company, operating gold mines in Mexico, is controlled by the Exploration Company; R. T. Bayliss is chairman, R. M. Raymond is managing director in Mexico, and A. F. Main is resident manager. During the year under review the tonnage treated was 285,181; the yield was $2,149,091 gold and $293,283 silver, or a total of $2,442,374. The recovery was 91½% of the gold and 77·7% of the silver, the total value being $8·56 per ton. The working costs in Mexico were $5·42 per ton, which is a slight increase over previous years, due to the greater amount of work at depth and additional pumping requirements. With regard to the extraction, the directors are intending to still further extend the tube-mill equipment. The ore is to be crushed coarser and four more tube-mills are to be erected. It is estimated that with this new plant it will be possible to treat as much in the No. 2 mill as is treated in both mills at the present time, so that it will be possible to suspend operations at No. 1 mill and in that way effect a considerable economy. It is reported that the recovery of the precious metals from the heavy sulphides in the lower levels is as complete as that from the oxidized ores. The ore reserves on June 30 were 383,269 tons averaging $9·10 gold and 4 oz. silver per ton, which is a slight decrease in amount as compared with last year. It has been difficult to continue development at depth owing to imperfect ventilation. The new shaft was down to 460 ft. on June 30, and should reach the 1000 ft. level in rather over a year. When this is completed the ventilation will be satisfactory and the development of the lower levels will proceed more satisfactorily. The English equivalent of the production was £498,244, and the mining expenditure, including depreciation, was £315,447. There was a profit of £11,000 on the railway, and of £21,361 on sale of shares and dividends received. Dividends amounting to £172,125 were paid, being at the rate of 15% on the paid-up capital. The total distribution to date has been £1,181,187, which is just a trifle over the nominal capital of the company, £1,147,500. In addition, £362,027 has been provided out of revenue for capital purposes.

PRÉCIS OF TECHNOLOGY

Studies in Amalgamation.—Two recent developments have caused Rand metallurgists to investigate the efficiency of amalgamation, especially with regard to the economical interval between the dressing of the plates. One is the introduction of the tube-mill, and the other the modification in the gold-stealing law. The presence of the tube-mill acts in two ways: First, the increased tonnage and the greater coarseness of the material passing over the battery-plates tends to keep the surface bright so that less 'black sand' is caught on the plates. On the other hand, there is a supplementary amalgamation on the tube-mill plates so that any decrease in the efficiency of the battery-plates may be corrected. As regards the other point, the new gold law provides that all amalgamating plates shall be covered by a screen, which is double-locked so that two white men are required every time the plates are dressed. This not only entails increased labour, but causes inconvenience by detracting from the efficient supervision of the mill. Hitherto, the usual practice on the Rand has been to dress the plates every four hours, and experiments have been tried at various mills with a view to increasing the interval from 4 to 8 or even 12 hours. The so-called 'black-sand' consists of small grains of pyrite containing sufficient free gold to attach the sand to the amalgamated plates.

At the June meeting of the Chemical, Metallurgical, & Mining Society, G. O. Smart, of the Simmer & Jack, read a paper detailing the results of his experiments. These go to show that frequent dressing is less advantageous than was supposed. During three months (November and December 1908, and January 1909) the plates were dressed at 8-hour intervals and during February, March, and April 1909 at 12-hour intervals. During the former period the extraction was 47·89% and during the latter 48·11%; at the same time the grading showed that during the latter period the pulp was a trifle finer than during the first period. The general result of the test showed that there was little difference in the efficiency of plates dressed at 8-hour and 12-hour intervals. A further series of tests were undertaken with a view to ascertaining at which hour after dressing the plates were the most efficient. The results showed that the extraction progressively improves up to six hours after dressing and then slightly falls off again. As a result of these experiments Mr. Smart decided to use the 12-hour interval. The author concludes his paper by recommending other managers not to alter the period without fully investigating the effect on their own ores, because the character of the ore must necessarily be a decisive factor. Also he points out that a sufficient setting of amalgam must be left after each clean-up, and that if plates are scraped down to bare copper, a practice only too common on the Rand, good amalgamation will not be obtained even with hourly dressings. The author is making similar tests on the tube-mill plates, where there is considerably more 'black sand.' Probably these plates will not run as long as the battery-plates without dressing, though preliminary tests show that they will run at least four hours. Further details on this point are to be given later. R. G. Bevington, in discussing Mr. Smart's paper, referred to the fact that the best amalgamation is effected six hours after dressing; he considered that this was because a freshly dressed plate is in a bright and slippery condition and will not readily catch 'black sand,' but after a time there is a sufficient gradual accumulation of sand to assist in holding up other particles travelling down the plates. The subsequent fall in efficiency would be due to an excessive accumulation of 'black sand,' sufficient to prevent the particles from adhering to the amalgam. W. R. Dowling, of Knight's Deep and Simmer & Jack East, gave some figures showing that the efficiency of the extraction at the combined mill was highest at 8 hours after dressing but fell off greatly at 12 hours; he considered that for this ore a 10-hour interval was best, though on account of the difficulty in arranging the work to fit the 24-hour day he had adopted the 8-hour interval. H. A. White mentioned that at the May Consolidated mill, the 8-hour interval has been adopted with satisfactory results.

Smelting Gold Precipitate.—Arthur Yates, of the Redjang Lebong mine in Sumatra, in a paper read before the Chemical, Metallurgical & Mining Society of South Africa, describes the method adopted at that mine for smelting the precious metals precipitated in the zinc-boxes. Two tilting furnaces of the Balbach or Faber du Faur type are used. This type of furnace is usually identified with the refining of zinc crusts and was first used for dealing with gold precipitate in Western Australia. The inside measurements of the retort are: mouth, 6½ in.; greatest diameter, 13¾ in.; diameter at bottom, 9½ in.; length, 30 in. The retort is placed at an angle of 30° to the horizontal and the mouth is closed during smelting with the stand of a No. 50 Salamander crucible. As supplied the furnaces were bricked-in on top and covered with a casting having a central feed-door. This arrangement was altered by the author so as to simplify the turning and changing of the retort, and to secure a better stoking. This was done by closing the top with three loose arches of firebrick, the bricks of each arch being clamped together with a strap 3 in. by ½ in. flat iron, with a ring bolt over the centre by which it may be lifted. A large loose fireclay tile was also placed over the neck of the retort within the front-plate casting. In this way the retort could be changed more easily; in case it should crack or cut through, a 2 in. hole plugged with ore slime was made in the centre of the furnace-bottom for the escape of metal and slag.

Until April 1908 the furnaces were worked with a mixture of charcoal and coke. With coke at £15 per ton it was thought advisable to adopt oil-fuel. As a matter of fact we believe that the Faber du Faur furnaces used in America and elsewhere are nowadays heated by oil-fuel, though details of the necessary alterations in the furnace do not appear to have been published. The coke-fired furnace is illustrated in Hofman's 'Metallurgy of Lead.' In making the alteration at Redjang Lebong, four Billow atomizers were obtained from the makers at Chicago, and two were used with each furnace. The furnaces were filled in with firebricks until a space of only 2 in. was left around the sides and the bottom of the retorts. Sitting on the neck of the retort in front, and supported on a brick in the flue at the back, half of an old retort, cut longitudinally, was fixed as a hood. Just below the retort, and centrally placed in the sides of the furnace, two pieces of 3 in. pipe were built into the brickwork, and in these the atomizers were placed, their brass shells being protected by a cover of 2 in. pipe screwed over them and projecting one inch in front. Kerosene oil is used. Each furnace has a 20-gal. oil storage-tank placed 18 ft. above the atomizers, with which they are connected with ⅜ in. pipe. Air at 40 lb. pressure is delivered through a 2 in. main with ⅜ in. branches fitted with ½ in. brass cocks and connected to the atomizers by ⅜ in. flexible metallic tube. To economise heat, and assist the vaporizing of the oil, the air supply main enters the stack at the junction of the two furnace-flues, and about 14 ft. of its length is coiled inside; this gives the air-feed a high temperature, and effects a saving of oil. The front casting of the furnace has a 2 in. sight-hole, fitted with a mica plate, through which the working of the atomizers can be observed. The two flames are set so that they point slightly upward and meet together just below the retort, with the result that the force of the jet is broken and the heat is distributed where most required. A white flame is used for a few minutes at the start until the atomizers and furnace are hot and vaporize the oil properly, after which more air is admitted and less oil, giving a blue flame, with complete combustion. With precipitate carrying only a small percentage of sand or slime, 1200 lb. can be run down between 6 a.m. and 4 p.m., or 600 lb. per fire per day, this being made up of two pours of about 300 lb. each. The retort will take 150 to 200 lb. of precipitate and fluxes on starting, the rest being added as the charge melts down. The consumption of oil may be reckoned at four gallons per hour for each fire, or one gallon of oil for 15 lb. roasted precipitate. Using oil the smelting occupies some 60 hours per month as against 140 hours with mixed coke and charcoal on similar material; that is, a European smelter and four boys are working 6 days per month as against 14 days, which, it will be allowed, is a very appreciable saving. To this saving of fuel must be added the easy control, the regular heat, and the cleanliness of the oil-fuel, as advantages that should appeal to cyaniders

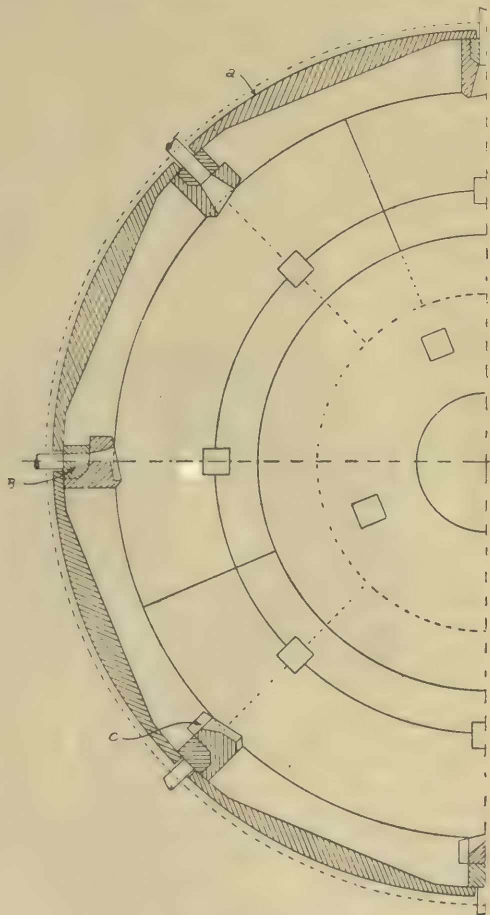
Wage Increments.—In the June *Journal* of the Chamber of Mines of Western Australia we find a scholarly article discussing the fundamental principles of political economy in relation to work and wages. Beginning with a reference to artificial efforts for regulating exchange in gold and silver, the writer advances to the adjustments between workmen and employers, collective bargaining, and the improvements in labour conditions. At one time Capital tyrannized over Labour, now Labour seeks to tyrannize over Capital, and artificial means are invoked to appreciate work and depreciate wages, relatively. The effect is to drive Capital to another country, for it is a fallacy to suppose that Labour is independent of Capital, while Capital is wholly dependent upon Labour. The converse is nearer the truth, under the complex conditions of modern life. The tendency to-day is to place a fictitious value upon Labour, as formerly it failed to receive fair valuation. Public sympathy, at first with the trade-unions in their struggle to gain for the working man his equitable share in the wealth he helped to produce, is still favourable to the militant trade-unionism that demands an excessive portion. Public opinion continues to be on what it considers the weaker side, disregarding the merits of each particular case. This has led to legislation, such as the Compulsory Arbitration Act, which was hailed as a panacea for all ailments of industrialism. The result has been disappointing; instead of an independent tribunal for the fair regulation of wages, the Act has created a legalized instrument for the advancement of wages irrespective of the condition of the industry affected or the merits of a particular case. The decisions have been partial toward the employees, and wages have been so raised as to imperil the economic situation in Australasia. The raise of wages has had the inevitable consequence of increasing the cost of living. The cost of a workman's living has gone up 25%, while his wages have advanced 10%. In New Zealand the general rise in wages under Arbitration Court awards is stated by the Attorney-General to be 18%, while the increase in the cost of living is 20%. The workmen complain that they reap no benefit from their increased wages, and demand more. Thus the conclusion is reached that it would be better if legislation ceased to tamper with wages, leaving the economic law of supply and demand to operate, tempered by voluntary negotiation between the parties concerned.

Working Costs in Cornwall.—Harold E. Fern, secretary of the London & West Country Chamber of Mines, contributes to the *Records* of the Chamber for September an interesting article on the working costs of Cornish mines. The companies operating in Cornwall are not notable for fullness and clearness in their published accounts. We quote Mr. Fern's remarks in detail.

A general comparative table of real value relating to costs in Cornwall is not possible owing partly to the absence of uniformity in charging up current development work and partly to the wide difference in working conditions. As regards the first point, some of the mines charge the whole cost to operating account, some wholly to capital and others divide it between capital account and operating account. In 'current development,' the author includes driving main levels and cross-cuts, deepening existing shafts, rising, etc., but not exceptional work such as new shafts. Such development work is a working cost, but it often happens that by excluding it, a mine can be shown to be paying its way. In some cases also a mine which is spending little on development shows a low working cost, whereas another mine vigorously developed will show a larger figure, and it is not until the comparative facts are ascertained that the relative merits of the methods pursued at the two mines are thoroughly understood. In fact, unless the working cost is correctly stated, the more vigorous mine suffers by comparison among the superficial critics. The author therefore lays it down that all mines should charge the cost of current development to profit and loss and that this item should be separated from the ordinary mining charges. As regards the second point, the difference in working conditions, the mining cost is naturally greater in the St. Agnes district, where the veins are narrow and much faulted, than in the Camborne district, where wide lodes are the rule. On the other hand the St. Agnes killas is easier to break than the Camborne granite. Then again in mines where there is much tributing the tonnage costs are greater, because the ore is brought up to a higher standard by the expenditure of labour before it is counted in the tonnage. Complexity of ore also affects treatment costs, and for this reason at South Crofty and East Pool the expense of dressing is higher than at Basset and Grenville. Pumping charges vary considerably owing to depth and situation of the mines, Basset being notably a victim in this way. Another difficulty under which Cornwall suffers is the so-called accounts issued by cost-book companies. These companies charge the whole of the expenditure to profit and loss and seldom separate the ordinary from the special items, so that it becomes hopeless to try to get an analysis of their accounts. It is no wonder that, quite apart from the question of unlimited liability, the average investor fights shy of cost-book companies. The author objects to the system pursued by many mines of lumping all the cost of labour into one general charge. The published figures do not divide the cost of labour into the different departments such as mining, development, pumping, and administration. It is impossible, for instance, to tell what is the cost of ore-dressing at Carn Brea. If such figures were given it would be possible to solve that most interesting problem, the relative costs of dressing at Carn Brea with its steam plant and at South Crofty with its electric installation, a question much discussed at present. Not many companies take the trouble to segregate costs for themselves, let alone for the benefit of their shareholders and the public. In many cases the directors do not consider the expense involved in a close analysis of the accounts to be warranted, though in actual practice in other parts of the world the saving due to close study has been enormous. For the same reason the Cornish manager decries the cost of keeping records of the contents of the ore and the extraction effected.

The author has prepared a specimen analysis sheet of operating accounts. Unfortunately, we have not sufficient space for it here and we refer readers to the orginal paper. He takes the costs and itemises them into 34 heads under the general divisions of labour, materials, and expenses of administration; he then divides the charges belonging to these divisions among the departments of mining, development, pumping, dressing, repairs and maintenance, depreciation, general administration, and royalties. He has also drawn up a comparative table showing costs published by nine of the leading mines in Cornwall. Several points of interest are made manifest; for instance, it is shown that the development at East Pool is only one foot to every 33 tons of ore milled as compared with one foot to every 4 tons at Wheal Kitty; and that the cost per ton milled varies from 20s. 7d. at East Pool to 41s. 9d. at West Kitty, with an average of 27s. The costs at South Crofty are 22s. 4d., at Dolcoath 28s. 7d., and at Carn Brea 24s. 11d. The paper is interesting not only as an indictment of Cornish methods, but as a contribution to the general discussion on the standardization of mine accounts.

Tube-Mills.—In the *New Zealand Mines Record* for April 1909, F. C. Brown, superintendent for the Waihi Grand Junction and Komata Reefs, describes the tube-mill liners invented by him. As these have been continuously in use since 1906, the author is now able to give details of their work, wear and cost. The accompanying illustration shows a half cross-section of the liners. The longitudinal plates A are of hard steel and are thickest in the middle, where the wear is greatest. The longitudinal shoes C, also of hard steel, serve to raise the pebbles and ore and throw them down. The bars B, shoes C, and plates A are held in position against the inside of the tube-mill by means of bolts. The bars B are not subject to wear and are made of tough iron. The ribs are arranged in such a way that there is no slip of pebbles on the liners and the correct rate of revolution has to be determined, so that the cascade shall be well regulated and the pebbles not thrown too far. For a 4 ft. mill the correct rate is 27½ revolutions per minute, and for a 4 ft. 6 in. mill, 24 revolutions give the best result. In a 4 ft. mill there are eight ribs, and in a 5 ft. mill ten ribs. Each rib for a 4 ft. mill measures 3 by 2½ in., and for a 5 ft. mill 3½ by 3 in. It will be seen that this system of liners is much thinner than silex liners, and in a 4 or 5 ft. mill the working surface is thereby made nearly 20% greater than in a mill of the same outside diameter lined with silex. The ore at the Komata Reefs is very hard. It is coarsely crushed in the stamp-mill, the woven-wire screen having only five apertures per linear inch. There are two tube-mills in operation, each is 16 ft. by 4 ft., and they treat between them about 100 tons per day. The grade of the feed is: Retained on 6-mesh, 5%; 40-mesh, 46%; 90-mesh, 26½%; 200-mesh, 8½%; through 200-mesh, 14%. After grinding, 60% passed 200-mesh. The results during 1908



Brown's tube-mill liner.

showed that the consumption of flints was 2·38 lb. per ton of ore and the cost, at 0·47d. per lb., was 1·11d. The consumption of steel in the liners, at 16s. per cwt., was 0·82d. per ton of ore. The total cost of wear was therefore 1·93d. per ton. It was found that a set of liners will last about 22 months. At the Waihi Grand Junction there are four tube-mills, having a total capacity of 205 tons per day. Two measure 19 ft. 1 in. by 4 ft. 8 in. internal diameter, one measures 16 ft. by 4 ft. 3 in., and one 12 ft. 6 in. by 4 ft. 3 in. The grade of the charge during 1908 was: Retained on 10-mesh, 6·2%; 20-mesh, 5·6%; 40-mesh, 19·8%; 60-mesh, 8·5%; 80-mesh, 7%; 100-mesh, 5·4%; 150-mesh, 10·3%; 200-mesh, 3·0%; passed 200-mesh, 34·2%. After leaving the tube-mills the grade was: Retained on 100-mesh, 0·6% ; 150-mesh, 6·7% ; 200-mesh, 5·7% ; passed 200-mesh, 87%. The flints consumed cost 1d. per ton of ore ; and the liners, 0·92d. ; a total of 1·92d. In order to get efficient reduction, returning-boxes in the nature of spitzkasten are employed at both the Komata Reefs and the Waihi Grand Junction, so that unground particles in the discharge are returned to the feed.

A Study of Refractory Materials.—A valuable paper on the conductivity, porosity, and gas-permeability of refractory materials was read by S. Wologdine at the Congress of Applied Chemistry held recently in London. The paper records the results of the investigations conducted by the author in the laboratories of Professor Le Chatelier, at the Sorbonne and the School of Mines in Paris. For the benefit of English and American readers the paper has been translated by A. L. Queneau and published in the *Electrochemical and Metallurgical Industry* for September. Mr. Queneau has also summarized the contents of the paper and given his own views of the points elucidated. Mr. Wologdine's studies are by no means complete, for the maximum temperature at which experiments were conducted was usually not greater than 1000°C. and only in a few cases as high as 1200°C. Presumably further researches will be made at higher temperatures. The ordinary industrial range of temperatures is from 1000° to 1700°, and in electric furnaces, of course, the heat is greater still. Silica, magnesia, and chrome bricks would not be used if the temperature of the furnaces was not to be greater than 1000°C. However, the paper as far as it goes is a classic, and will whet the appetite of the metallurgist for more from the same source. Mr. Queneau's summary of conclusions is as follows:

(1). Due regard being given to the question of fusibility, all clay bricks, terra-cotta bricks, building-bricks and fire-bricks have practically the same coefficient of heat-conductivity. The coefficients are differentiated solely by the temperature of burning and not by the character of the clays or their chemical composition.

(2). In all refractory materials, including special bricks, such as those made of chrome, magnesia, carborundum, and graphite, the heat-conductivity is a direct function of the temperature of burning.

(3). The value, for insulation purposes, of silica bricks when burned at a moderate temperature, 1050°C., is due to the fact that their coefficient of heat conductivity is practically equal to that of kieselguhr brick and only one-half of that of clay brick. Further determinations on this point might with advantage be made by other investigators.

(4). Chrome bricks have the unique characteristic that their coefficient of heat conductivity is independent of the temperature.

(5). To secure efficient heat insulation, refractory materials should be burned at the lowest allowable temperature, that is, the maximum temperature to which the bricks will be exposed in the furnace. It is necessary to burn at this maximum temperature in order that the brick shall not shrink after being set. Though this fact is well known, it is often neglected ; a shortening of the life of the furnace is the result.

(6). The relative conductivities of various bricks are as follows: Graphite brick, 100 ; carborundum brick, 92·4 ; magnesia brick, 28·4 ; chrome brick, 22·8 ; fire-brick, 16·7 ; bauxite brick, 13·2 ; terra-cotta brick, 9·3 ; silica brick, 7·8 ; kieselguhr brick, 7·1. These are the figures for average samples and do not include either extra pure or inferior grades.

(7). Remarkable variations in the permeability to gases are exhibited in the same bricks with increases of temperature. In one instance the permeability varied from 3·3 litres per hour to 241 litres per hour. This shows the need of carefully selecting the clay mixtures used for certain purposes, such as the distilling of zinc, where permeability has a decided influence on the recovery of the metal. The impermeability to gas of graphite crucibles is worthy of note.

(8). The permeability of bricks in blast-furnace linings has an important effect on their life owing to the destructive action of carbonic oxide when it comes in contact with the iron oxide present in the bricks.

Copper Smelting at High Altitudes.—R. L. Lloyd, an American metallurgist of wide experience and identified with the Dwight-Lloyd sintering process, read a paper before the Mexican Institute of Mining and Metallurgy on his blast-furnace practice at Cerro de Pasco, Peru. Mr. Lloyd happened to be in Chile two years ago just at the time that Frank Klepetko was starting the Cerro de Pasco smelter, and his advice and services were requisitioned for the purpose of overcoming the serious initial difficulties. The smelter is situated 14,000 ft. above the sea, where the barometric pressure is less than 20 inches. Allowance had been made for the rarity of the air by the provision of increased blast-pipes and other equipment, but nevertheless the efforts to start the first furnace were fruitless, for short runs were followed by bad freeze-ups.

Before entering into details of the method by which these difficulties were overcome, it is necessary to describe briefly the plant and the ore. There are three furnaces of the straight type, such as are to be found at Great Falls, Anaconda, and Ducktown. The dimensions at the tuyeres are 56 by 180 in., and at the charging-floor level 72 by 180 in. ; these are capable of carrying a 14 ft. column. The converters are of the upright Great Falls type, with improvements to facilitate handling, repairing, and lining. It is notable that Mr. Klepetko thus reverted to the upright type after having installed the barrel type at the Washoe smelter. The relative merits of the two types would form an interesting topic for discussion. The ore is a copper sulphide, together with pyrite and some pyrrhotite, carrying a little lead and zinc, but not a sufficient quantity to affect good work under ordinary conditions. The ore is not high in silica. The flux is a fairly good limestone, and was at first used in large pieces. The coke was an extraordinary material, carrying no less than 54% ash.

When the author arrived the furnace had been running about three days, and was on the point of stoppage. The slag was running cold but was apparently fusible enough ; subsequent analysis showed that under ordinary circumstances it would have run without trouble. The matte was low grade, and came by fits and starts, sometimes running to the exclusion of slag and sometimes not coming at all. On top the furnace was an exaggerated blowhole, while the rest of the charge was a solid hard crust. It was a case where it was economical to dig out the charge and start afresh. The furnace froze up shortly after, making the seventeenth occurrence of the kind in a few months. The metallurgists and their workmen were all disheartened—physically and mentally exhausted. The terrific blast of 56 oz. and the unusually bad quality of the coke were two factors that seemed the possible causes of the failure ; it could not be attributed to poor work, for the whole staff was thoroughly conversant with the furnace and the method of smelting. Some of the men were inclined to blame the mechanical feeding, a complaint often heard when new furnaces are started, but as both Mr. Klepetko and Mr. Lloyd had had plenty of experience in this line, the argument had little weight. In starting to make a thorough investigation, the author first examined the crusts dug out of the furnace and found that they consisted chiefly of silica. The sulphides had been liquated out, and there was very little lime left. In making up the next charge the author had the limestone and coke broken smaller, as there was a suspicion that the large pieces got out of place in the charge. He changed the sequence of the various parts of the charge so that the lime and the slag would tend to fall more toward the ends of the furnace. The ore, lime, and slag were put into the furnace by cars as usual, but the coke was fed by hand so as to ensure the distribution desired. The charge from the cars was spread evenly over the entire width of the furnace, while a larger proportion of the coarse material fell in the centre. This is a delicate operation and requires a careful discharge from the cars, and the maintenance of the correct distance between the charge-floor level and the stock-line of the furnace—in this case a distance of 10 ft. above the tuyeres. The sides and ends were allowed to receive rather more coke than their due proportion. The charge of coke used was adjusted so as to give the same carbon as 11% of coke carrying 12% ash. In order not to disregard the blast the author took off the gauges and relied on the sound of the escaping gases at the stock-line and the appearances at the top of the furnace. The author used a slow start. Coke was charged into the furnace on top of burning wood until it stood about a foot over the tuyeres. When it was glowing throughout under natural draught, 12 charges of fusible slag were added, and afterwards 10 charges consisting half of fusible slag and half of normal charge. Subsequently normal charge was added up to the stock-line. The charges weighed 2200 lb. The tuyere caps were then put on, leaving only the 1½ in. bar-holes open, and the furnace was allowed to stand without blast for about four hours. The blast was then put on, and two hours after slag appeared at the tuyeres. The bar was then drawn at the spout and a good hot slag began to run. After the settler had filled, the furnace became tighter. The blast was then increased gradually so as to keep the sound all right. In 24 hours the furnace was running normally, though slowly. In 48 hours, on the re-setting of the gauges, it was found that the pressure was only 24 oz. The author was of opinion that a higher pressure might be used, but considered it best not to try to do so owing to the fear of crusts and his unfamiliarity with the ores. Under the new conditions of blast the smelting went on perfectly satisfactorily, though slower than under normal conditions of atmospheric pressure. The author found that the furnace-duty per square foot of hearth-area decreases approximately with the fall in the barometric pressure, and that the oxidation of sulphur is rather less in high than in low altitudes. The matte produced at the furnace ran about 35% ; probably with a similar charge at a lower altitude a 45% matte would be obtained. On account of the slower running at high altitudes the author recommends an interior lining of chrome brick instead of a water-jacket, so as to prevent radiation and possible freezing, this suggestion being more particularly applicable when the matte inclines to a higher grade. The author also recommends that furnaces in high altitudes should not be too wide at the tuyeres and that the diameter of the tuyeres should be larger ; in this way ensuring efficient penetration and the supply of sufficient air at reasonable pressures. As regards the working of converters at high altitudes the author did not experience any difficulties and found that the conditions were practically the same as are usually experienced. This is an excellent contribution to the records of the metallurgical profession.

Sampling of Ore.—At the September meeting of the American Institute of Mining Engineers an important paper was read by D. W. Brunton, the president of the Institute, on the subject of modern practice in ore-sampling. Mr. Brunton is himself engaged in the business of sampling ores, his firm (Taylor & Brunton) having held a leading position in the business for many years, owning sampling works in the mining districts of Colorado, Utah, and Nevada. Thus he brings to the discussion of the subject not only technical ability, but also the business acumen that underlies successful work. Starting with an appropriate condemnation of the old-fashioned 'grab' sample, he proceeds to describe the modern machine that takes a sample with mathematical precision. Incidentally it is emphasized that the determination

A drawn cone,
Showing poor mixing of ore in sample.

of moisture in the ore is quite as important as the ascertainment of its metallic contents, for the moisture-sample decides what percentage of the weight is to be excluded in the settlement between the buyer and seller. Sampling by shovel is condemned as constituting a method of selection trying to the honesty of the operator and subversive of morality. The quartering of samples in order to reduce their bulk is a method fairly accurate when performed skilfully, but it affords too many possibilities of accident and error. The inherent defect of this system is the fact that the ore piles up in the form of a cone without really mixing ; the cone is not homogeneous, the piling of shovelful after shovelful inducing a sorting effect, whereby the fine tends to the centre, and the coarse to the periphery. The photograph of a bisected cone is given by the author to illustrate his contention. Thereupon he advocates coning around a rod, so as to maintain the centre, ending with a flattening of the mass, and division in quadrants with steel blades. To avoid the irregularities and the expense of 'quartering,' the split-shovel was introduced. By this system the ore is thrown from a broad shovel upon a narrow V-shaped shovel, the latter being placed directly above a car or wheelbarrow. But this method was not a great improvement, because it left room for carelessness. Then came the machines for subdividing a falling stream of ore. It was supposed that the ore-stream was homogeneous, but investigation and experience have proved that this was a theory only; hence mechanical devices for taking a portion of the ore-stream all the time have been displaced by machines for taking all the ore-stream for a portion of the time. As Mr. Brunton says: "It is not practicable to produce a stream of ore which shall be continuous in value through every part of its length, any more than it is possible to produce a stream of ore that is constant in value throughout its width; but by taking a small sample entirely across a falling stream at very short intervals it is found that, while no single cut would give an exact representation of the composition of the entire lot, the average of thousands of these small samples is so nearly correct that results can be duplicated within very narrow margins, or, in other words, that individual errors are balanced." This is the idea underlying the Snyder, Vezin, and Brunton samplers; and the application of it was aided by an improvement in ore-crushing machinery, whereby continuous operation and fine reduction were rendered possible economically.

Uranium and Radium in Cornwall.—E. W. Newton contributes an article on this subject to the 76th annual report of the Royal Cornwall Polytechnic Society. Since the restrictions were placed by the Austrian Government on the export of uranium ores, efforts have been made to obtain them from other sources. With the exception of one locality in Norway, Cornwall is at present the only other district where they are to be found in anything like commercial quantities. From 50 to 100 years ago extensive copper deposits were worked in Cornwall, the metal occurring as native copper and as oxides, sulphides, and phosphates, and it was in association with these that uranium ores were found, in all the chief districts, such as St. Just, St. Ives, Camborne, Gwennap, and also in East Cornwall at Gunnislake, Callington, and Liskeard. There can hardly be any doubt that uranium ores will be found in the old workings and on the waste heaps of a large number of these old copper mines. The ores found in Cornwall are pitch-blende, uranite, and autunite. The first-named is too well known to require description. In many cases it is found with a beautiful lemon incrustation consisting of a higher oxide known as uran-ochre. When pitchblende has been exposed to the weather for some time it usually bears traces of this yellow oxide, which thus affords an indication of the presence of the uranium mineral. Pitchblende has been found at the following mines: Levant, Owles, Botallack, St. Ives Consols, Trenwith, Providence, Buller, Basset, East Pool, Tincroft, and at several mines in Gwennap and Callington districts. But the most regular producer as yet is the South Terras mine at Grampound Road between Truro and St. Austell, where it occurs with iron and arsenical pyrites. Uranite is a hydrated phosphate of copper and uranium. It is a beautiful mineral, consisting of brilliant emerald-green crystals and it contains 61% uranium oxide and 9% copper oxide. Magnificent specimens have been found at Gunnislake, and at Fowey Consols, Buller, Basset, and Tincroft, but it does not occur in commercial quantities and practically every piece found goes to a museum or other collections of minerals. Autunite is a hydrated phosphate of uranium and lime. In colour it varies between orange and lemon, and it contains about 60% uranium oxide. It was found at Buller 35 years ago as small patches of crystals associated with black oxide of copper, and in an impure form in three or four other places, but the total amount discovered has been very small. At the present time pitchblende is the only probable source of radium, and the only Cornish mines where it is known to exist in commercial quantity are Trenwith, Providence, and South Terras.

Manufacture of Cyanide.—William Bettel contributes to the *South African Mining Journal* some interesting records of a process for manufacturing cyanide, using atmospheric nitrogen, that was used in a plant in Scotland now closed. Mr. Bettel does not give the name of the firm, but he obviously refers to the Scottish Cyanide Co., of Leven, Fife. His remarks relating to the failure of the process were prompted by the proposed introduction of a nitrogen process in South Africa. As the process used by the Scottish firm has never been described, it is suitable to quote the description here, so that the record of experience may be useful to those who contemplate similar operations. According to this process, charcoal was soaked in a saturated solution of potassium carbonate, and then drained and dried. It was then charged into retorts and heated in an atmosphere of dry nitrogen, free from oxygen, obtained from the air. When the absorption of nitrogen ceased, the charge was drawn from the retorts but not allowed to come in contact with the air until it had been cooled by the incoming stream of nitrogen. About 25% of the potassium carbonate was converted into cyanide. At the same time some metallic potassium was formed by the reduction of the carbonate by the charcoal. Under conditions which were never exactly ascertained gaseous potassium carbonyl would be formed, causing trouble owing to its explosive properties. After the charge was cooled it was lixiviated and the cyanide and carbonate leached out. The solution was then passed through a tower filled with coke, and subjected to the action of carbonic acid supplied by a slow-combustion coke stove. The effect of this reaction was to reduce the potassium cyanide and to form hydrocyanic acid and potassium carbonate. A current of pure nitrogen was also passed through the tower and served to carry the hydrocyanic acid gas into another tower, where it was absorbed by a cold-water spray. The solution exhausted of its cyanide coming from the first tower and containing only potassium carbonate was used over again in saturating the leached and dried charcoal ready for another charge. The solution of hydrocyanic acid obtained in the second tower was sent to stills, where the acid was evaporated. As some water vapour passed over with the gas it was sent through cooling coils to precipitate the water. The pure hydrocyanic acid gas was subsequently liquified and allowed to drop into caustic soda with the formation of a hydrated sodium cyanide ($NaCN, H_2O$). The crystals of this compound were extracted from the solution and dried in centrifugals. Some caustic soda adhered to the crystals and eventually—on contact with carbonic acid in the air—was changed to carbonate. By long continued drying the water of combination could be largely removed. When the work was started it was figured that the cost of production would be about 3d. per lb., but in practice the actual cost was nearer one shilling. The reasons for this high cost could be classed under five heads: (1) the loss of potassium carbonate owing to the reaction with silicates in the ash of the charcoal and coke; (2) a similar loss by the formation of sulphide by reaction with sulphurous gases coming from the coke; (3) waste of charcoal from oxidation due to the porosity of the retorts; (4) excessive wear and tear of the plant, especially that due to damage by explosions; (5) high fuel-consumption for power and heating.

Copper Mines in Shasta, California.—In the *Engineering and Mining Journal* for August 28, George A. Packard, an engineer of reputation, gives a lengthy article on the copper mines and smelters of Shasta county, California. This subject was treated with equal detail by Donald F. Campbell in the *Mining and Scientific Press* for January 5 and 12, 1907, but since then the mines have been further developed and additional smelters have commenced operations. As the district is an important copper producer, we abstract Mr. Packard's article. Shasta county is in the northern part of California. It is served by the Southern Pacific railway, which follows the Sacramento valley. This valley is broad and flat to the south, but after Redding is passed in the

The Shasta copper region, California.

journey northward, the scenery changes, and the mountains close in abruptly. The accompanying map shows the copper district, and marks the mines and smelters. The deposits occur in two separate areas of granite-porphyry one on each side of the Sacramento river and separated from each other by eight miles of sedimentary and igneous rocks. On the west side of the river the chief mines are the Mountain Copper, the Balaklala, and the Mammoth, while to the east, the principal mine is the Bully Hill. In these two separate areas the copper deposits occur in totally different forms and much discussion has taken place with regard to the era of their origin and of the igneous rocks in which they are found. West of the river the ores are a mixture of pyrite, chalcopyrite, and some blende, with here and there some chalcocite and covellite containing gold and silver. Pyrite predominates, and in some places the sulphur and iron contents are high. For instance, at the Mountain Copper and the Balaklala large bodies of ore containing 40% sulphur are found. The copper content varies from 2½ to 7% though there is little left of the higher grade. The orebodies consist of a series of overlapping lenses of irregular size and shape separated by tongues of less mineralized porphyry. Each lens contains from a few tons to many thousands of tons of ore. They are usually bounded by well-defined fissures, and consequently it is possible to measure the extent of the deposits. Owing to the mountainous nature of the district the mining is done through adits. The district east of the Sacramento river presents entirely different characteristics. Here the orebodies exist as vertical veins, and mining is done by shaft. The ores occur in shear-zones on the contacts of granite porphyry with a later basaltic rock; they consist of chalcopyrite, bornite, and chalcocite, mixed with blende and some galena. Barite also is found and it contains both gold and silver.

The first of the mines to be discovered was that belonging to the Mountain Copper Co. The chief orebody was hidden under a great depth of gossan, and owing to secondary enrichment had a high copper content. This mass is now practically worked out, and the company depends on the sulphur contents of low-grade chalcopyrite obtained from the adjoining Hornet mine. In 1880 the gossan was worked for its silver, and in 1884, 20 stamps and a pan-mill were erected for the purpose of extracting the precious metals. It was not until afterward that the great body of sulphides was discovered. In 1895 the property was sold to the present English company and for a few years the output of copper from the 7% ore was large. The company's smelter at Keswick caused litigation over fume, hence the transfer of the main smelting operations to the newer plant at Martinez on San Francisco bay.

The next mine is the Balaklala, owned by the company of that name, which in turn is controlled by the First National Co. The amount of ore actually blocked out is over 1,000,000 tons averaging 2½% copper, 50 cents gold, and 0·8 oz. silver. The smelting plant has been built at Coram on the Southern Pacific railway; part of it was put in commission during 1908, but it was only this spring that the full capacity was attained. In addition to the Balaklala output, the smelter treats ore from the adjoining Shasta King mine, of the Trinity Copper Co., and is also open to custom work.

Three miles up the valley is the Mammoth mine, controlled by the United States Smelting Refining & Mining Co. The ore averages 4½% copper and contains 80 cents of gold and 2 oz. silver. The sulphur content is as high as 40% and there is also 4% of zinc in the ore. The smelter is at Kennett. There are five blast-furnaces each 180 in. long, and from 50 to 56 in. wide. It is necessary to employ a cold blast owing to the presence of zinc, and 4% of coke is used.

The Bully Hill property is 14 miles east of the Mammoth, and consists of three mines, the Bully Hill, Rising Star, and Copper City. The valleys adjacent contained placers that were worked as far back as 1850, and later a stamp-mill treated some of the surface ore. In 1899 the properties were bought by J. R. De Lamar, who erected a smelting plant. Subsequently they were sold to people connected with the General Electric Co. Smelting was then suspended while the mines were further developed, and eventually sufficient ore reserves were found to justify the construction of a railway up the Pitt river. The smelting problem has not proved easy, but the furnaces are now in full blast.

Use of Concrete in Mining.—W. R. Crane, in the Transactions of the Institution of Mining Engineers, has an interesting paper on this subject. The greater strength of concrete as compared with timber is especially marked in certain applications such as shaft-lining. Reinforced concrete is now employed in shafts, tunnels, gangways, in the support of stations, in building dams underground, and, in fact, in all mining work both within and without the mine. As compared to stone and brick, concrete can be more readily placed; less skilled labour is required, and the first cost is usually less, but much more time is necessary, even as much as three times that required for timber, thus increasing the final cost of construction.

COMPOSITION AND PROPERTIES.—The character of good cement can be improved by re-grinding, which decreases the time required for both initial and final set, and ensures greater strength at the end of shorter periods of time. The usual proportions for various mining purposes are:

Class of Work.	Ratio of Volume. Cement.	Sand.	Stone.
Walls*	1	1	2
Retaining-Walls	1	1½	3
	1	2	4
Shaft-Lining	1	2	5
Foundations	1	2½	5
Dams	1	3	6

The prime requisite for the sand is that it shall be clean and sharp. If the grains are coated with slime the concrete loses both in speed of setting and in ultimate strength. Further, natural sand when properly graded gives a higher tensile strain than crushed stone. The aggregate should consist of gravel, broken stone, or similar high-grade material. Gravel is preferable, as it can readily be worked into difficult positions, but it should not exceed ¾ in. size for reinforced concrete. Other things being equal, the strength of concrete is proportional to the cement content, although the method of mixing has an important bearing. Its tensile strength being relatively low, concrete should be employed under compression, but by the use of reinforcements it may be made to resist both compressive and tensile strains. The first cost of concrete is less than timber, brick, or stone, yet, owing to the time required in placing, the ultimate cost may exceed that of timber. From actual experience it has been shown that concrete exceeds timber in its first cost from 25 to 45%, the variation depending upon the shape of the construction. In reinforced concrete, the reinforcing members may be plain, corrugated, serrated, or crimped. While plain forms are in common use, those with a mechanical bond are preferable. Plain iron rods slightly crimped are frequently used, as are expanded metal and wire screening. However, for certain purposes old wire rope and steel rail have no equal as reinforcing elements. The concrete should not be dry, but rather a 'wet mix'; while too much water is not desirable, it is better than too little. When placing the concrete about the reinforcement, some jarring or movement of the members is desirable to ensure the concrete filling the form accurately. Dirt, oil, and grease should not be tolerated, and all junctions or bondings of old with fresh concrete should receive special attention.

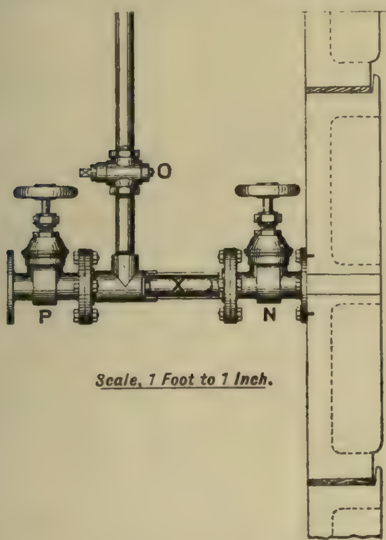
SHAFT-LINING.—Rectangular concrete shaft-linings have been successfully constructed in the United States, but practice favours the elliptical forms. Only about half the thickness of lining is necessary when curvilinear forms are employed; therefore, although they are not economical of space, the size of excavation is actually reduced and the cost of the concrete lining is practically halved. Drop-shafts have been sunk at Bridgeport, Pennsylvania, and elsewhere. At Bridgeport the inside measurements are 23 by 15 ft., through loose surface material. The drop portion was rectangular outside, but arched at the sides and ends inside. It was sunk with a shoe and controlled in the usual way by removing material evenly from beneath it. From 20 to 30 ft. of forms were first erected and 10 to 12 days allowed for setting. As the lining sank, fresh concrete was added. When the shoe came to rest upon a hard shale above the coal, an excavation was cut for a foundation ring some 5 ft. below, and a shell of concrete built to the shaft above. The shaft was then sunk to the coal and lined with concrete. Iron pipes were laid in the concrete in order that excess of water might be drawn off; when the concrete had set, caps were screwed on and the flow of water checked. The division of the shaft into compartments was accomplished by setting three lines of 8 by 12 in. angle irons or buntons in holes chiselled into the walls, and, when placed, ramming fresh concrete around them. Re-lining timbered shafts with reinforced concrete has also been successfully accomplished, as at the Manville, near Scranton. This had been formerly lined with 12 by 12 in. timbers and further supported by an inner lining of timbers, the 6 in. space left between the two shells being filled with tamped clay. The re-lining, made by removing the inner shell of timbers together with the clay packing and placing concrete in its stead, was begun at the bottom of the shaft and proceeded upward by stages until the surface was reached. The outer timbers were left as a support to the walls while the concrete, which was 18 in. thick, was being placed. Two of the compartments were re-lined in this manner but in the air-way a 12 in. concrete wall was built, within the original timbers, thus reducing the size of the compartment by 12 in. on all sides. The partitions dividing the shaft into compartments were broken up into buntons by leaving large oval openings, the old timber buntons being removed before building the dividings.

LINING DRIFTS AND GANGWAYS. — Concrete props have proved successful. The substitution of reinforced concrete for timber is well illustrated in the mines of the Philadelphia & Reading Coal Co. In many cases long spans are necessary and arches supported on columns are constructed. These are spaced at 5 ft. intervals; the first arches were made 24 in. square reinforced by old 25 lb. rails roughly bent to shape but the last built have been reduced to 18 in. square and are reinforced with old wire rope woven backward and forward through the concrete.

STOPPINGS AND OVERCASTS.—The use of concrete reduces the resistance to air-currents. The floor of the overcast is reinforced with 25 lb. T-rails spaced 2 in. from the lower side of the 12 in. concrete bottom. Stoppings are set into the walls, roof, and floor to a sufficient depth to prevent leakage of gas or air and give adequate strength. Large bulkheads, 12 ft. square by 9 ft. thick, are also built into gangways and tunnels as a protection from water, the walls being recessed to a depth of 3½ ft. at the sides and 2½ ft. at the top and bottom.

Stringers in Inclined Shafts.—Concrete for the support of tracks has proved eminently successful, being used as a long continuous stringer upon which the rails rest. Preparatory to placing the stringers, the floor of the shaft is cleared of loose material, and the mould-boards placed, but, before placing the concrete, the space within the mould is flushed to bed-rock thus ensuring a clean face. Through the centre of each stringer runs an old 1½ in. wire rope, which is the only reinforcement necessary.

Stopping a Leaking Shaft.—W. O. Wood, in a paper read before the Institution of Mining Engineers in September describes an interesting variation in



Elevation of Hydraulic Injector.

Section of Cartridge

Portier's method of stopping leaks in shafts by means of portland cement. The shaft at the Murton colliery, Durban, was sunk in 1838. The cast-iron tubbing became weak and leaky in 1891, so a new tubbing was inserted without disturbing the old, the space between being filled with concrete. For certain reasons, the lower part of the new tubbing settled, but the upper part did not, and at one point there was an opening of 1½ to 2 in. all round the shaft, through which water entered under pressure at the rate of 150 gal. per min. Various mechanical means were adopted for stopping the leak, but without avail. Then Henri Portier was engaged to apply his method, which had already won success in France and Belgium. Briefly his system is to drill holes in the tubbing above the leak and insert pipes having taps just outside the holes. The pipes are connected with feeders at the top of the shaft and they carry a flow first of crushed stone and brick of ⅛ in. size, subsequently fine sand, and finally portland cement. The pressure of the water in the pipes is sufficient to force the materials into the space behind the tubbing. The concrete sets and eventually stops the leak. At the Murton pit, however, an unexpected event happened: instead of the leak ceasing, it burst out with double flow. The cause was attributed to the cutting action of the sharp crushed material on the delapidated inner tubbing and old concrete filling. A different material was then requisitioned in the shape of lead shot, and four modified inlet pipes as shown in the accompanying drawing were inserted around the shaft. The lead shot, ¼ in. diam., were wrapped in cartridges of brown paper with a bullet 1 in. diam. in front. The tap *O* being turned off, the valve *P* was opened and the cartridge inserted to take up a position at *X*. The valve *P* was then closed and the valve *N* opened. On suddenly opening the tap *O*, the pressure of water in the pipe, 200 lb. per sq. in., forced the cartridge inward against the old tubbing, where it burst and scattered its contents. This operation was continued at all four points until 1300 cartridges were injected. The leakage was thus reduced from 300 to 125 gal per min. The bottoms of the valves *N* were then connected with the pipes previously used for feeding in the concrete. First of all smooth gravel from ⅛ to ¼ in. was fed, and subsequently sand and cement; the total of gravel, sand, and cement was 14½ tons, and the time occupied 12 hours. The leak then ceased to flow and in a few days the cement, having firmly set, the joint became perfectly dry.

Metal Losses in Copper Slags.—Lewis T. Wright, manager of the Mountain Copper Co., communicates some useful information relating to the extraction of precious metals from copper slags in a paper appearing in the September *Bulletin* of the American Institute of Mining Engineers. After extended observations the author discovered that the ratio of gold, silver, and copper contents in the slag was not the same as the ratio of the same metals in the matte. Invariably there is a much smaller ratio of gold and silver to copper in the slag than in the matte. He came to the conclusion therefore that the copper that will not settle from the slag does not occur as prills of matte but is in combination with some constituent of the slag. The author gives details of experiments on the subject. One of the deductions made is that if a slag formed in making a matte having a certain metal ratio is kept in molten contact with a matte possessing a different metal ratio, the slag will acquire a new metal ratio due to that of the matte. The matte and slag appear to act as solvents and divide the metals accordingly. For instance, if slag formed in making a matte carrying a large quantity of precious metals is kept in molten contact with matte containing a small quantity of precious metals, the silver and gold will go out of the slag into the matte, although the percentage of copper in the slag will remain constant. In this way he devised a method of cleaning slags of their precious metals. He built three reverberatories, the middle one being at a lower level than the outside ones. The charges smelted in the latter yield a matte containing high precious-metal values, while that in the middle yields a matte low in precious metals. The slag from the outside furnaces is tapped through the middle furnace. Thus all the slag produced in both the outer and inner furnaces can be discharged low in copper, gold, and silver. The middle furnace is found to smelt 6% more ore-charge than the two outer ones, and to consume 17% less fuel. The slag from the outer furnaces, of course, is not considered part of the ore-charge of the middle furnace. By using this method the precious metals are more fully recovered, with an accompanying increased furnace-output and an economy in fuel-consumption.

BOOKS REVIEWED

ORE DRESSING.—By Robert H. Richards. Vol. III and IV. 8vo. 850 pages. Ill. McGraw-Hill Book Co., New York. Price 42s. For sale by *The Mining Magazine*.

The publication of these two volumes supplements the two-volume book issued in 1903. The author is professor of mining engineering and metallurgy in the Massachusetts Institute of Technology, at Boston, and needs no introduction to those engaged in mining. By preparing these two volumes, together with an index (which constitutes a separate and fifth volume), Mr. Richards has completed a monumental task, which will ensure his abiding fame as a specialist in the wet treatment of ores. It will be open for technical men to criticize the voluminous character and the consequent cost of this tremendous treatise, but these drawbacks are inevitable from the bigness and intricacy of the subject. Moreover, the time necessary to the preparation of the successive volumes, or even chapters, has been so great that some of the earlier portions have been out-of-date by the time the concluding paragraphs went to press. Even in preparing these last two volumes the author was compelled to enlarge his matter from a small supplement or appendix to dimensions fully equal to the original publication. Meanwhile the revision of Vol. I and II was prohibited by the fact that the details are so interwoven as to preclude any method not involving re-writing. Indeed, we sympathise with the author, who is known to be as painstaking as he is accurate, for new concentrating devices and even new principles of ore dressing have succeeded others so rapidly as to embarrass a conscientious student desiring to be a trustworthy teacher. In order to avoid the revision of the first two volumes while yet adding the latest available information, the author has given us two additional volumes in which the subject-matter of Vol. I and II is supplemented chapter by chapter. The fifth volume is an index that binds the four volumes together. Thus the reader is practically compelled to purchase Vol. III and IV in order to obtain the corrections and amplifications of the matter appearing in Vol. I and II; at the same time the buyer of Vol. III and IV will have only a lordly fragment of technical information until he completes his purchase by obtaining the first two volumes. The index is supplied free to purchasers of Vol. III and IV. We confess that we do not like this feature of the publication, but we suppose that it was unavoidable. Certainly the cost of books of this kind is insignificant compared to the information they give; a single page, even a paragraph, will often contain data worth a hundred times the price that an engineer may have paid for the privilege of owning so comprehensive a technical guide. In one chapter Mr. Richards gives details concerning 94 representative mills in the principal mining centres of the world; he publishes data concerning cost, power, extraction, arrangement, and so forth, in such detail as to give figures and facts of the greatest value to anyone engaged in this branch of metallurgy. In another chapter the cost of milling is elucidated with elaboration, affording a wealth of practical information. We venture one criticism: the author practically ignores the air-cushion stamp. In the first edition the working of this stamp, owing to its misleading name—the 'pneumatic stamp'—was misinterpreted. In the second edition, some information was given concerning one or two stamps of this type that had proved to be failures. In Vol. III just published, the whole subject is dismissed in a few lines, with the remark that this type of stamp is not gaining ground. As a matter of fact, the air-cushion stamp has run successfully at Dolcoath for several years, and an additional installation is now being erected. Similarly the experience at East Pool has induced the engineers to increase their plant. In South Africa, it is being tried at the New Kleinfontein, as was mentioned in our September issue. The air-cushion stamp has its limitations, but, being in successful operation, it deserves a place in an encyclopedia of ore-dressing. We congratulate the author on fulfilling his purpose in giving technical literature a treatise so comprehensive and so trustworthy.

T. A. R.

IGNEOUS ROCKS.—By Joseph P. Iddings. Vol I. 8vo. 640 pages. Ill. New York: John Wiley & Sons. London: Chapman & Hall. Price 21s. For sale by *The Mining Magazine*.

This treatise is devoted to the composition, texture, classification, description, and occurrence of igneous rocks. It is prepared by a recognized authority and is in accord with the latest understanding of the chemical and physical principles involved in the problems of petrology. The author is already known as a writer on the subject, his earlier researches in the field as an officer of the U.S. Geological Survey having been supplemented by investigations made recently in the geophysical laboratory of the Carnegie Institution at Washington. The application of the theory of solutions to igneous magmas has enlarged the conceptions of physical chemistry and has aided the elucidation of the phenomena of crystallization, as shown by Vogt, who followed the leadership of Bunsen. The author, in turn, has used the line of attack cleared for him by Vogt and has given a scholarly volume on a subject the complexity of which is usually the despair of mining engineers.

THE DRESSING OF MINERALS. By Henry Louis. Cloth. Large octavo. 555 pages, with over 400 illustrations. London: Edward Arnold. Price 30s. For sale by *The Mining Magazine*.

This book by the professor of mining in the Durham University differs from the similar textbook by the professor of mining engineering and metallurgy in the Massachusetts Institute of Technology in that it is not so encyclopedic as eclectic, and consequently it is easier read by the student. Richards's book presupposes a fairly complete knowledge of the principles of crushing and concentration and is occupied with supplying details, whereas Louis' book deals with general principles and tells us why certain plant is used for certain purposes. In the first chapter the author discusses the general principles of the problem of concentration. The second is devoted to sizing and screening; this is treated in great detail. In the third chapter, sorting and picking-tables and belts are described as also are washers for removing clay and dirt. The fourth chapter deals with comminution, and describes rolls, crushers, stamps, ball-mills, and tube-mills. A large portion of the book is naturally devoted to classifiers, jigs, tables, and buddles; special plant such as pneumatic, magnetic, electrostatic, and oil concentrators also receive detailed attention. Another chapter deals with accessory appliances, such as tipping-cars, storage-bins, feeders, conveyors, elevators, tailing-wheels, etc. Chapters are devoted to coal-washers and the concentration of iron ores. One of the most interesting chapters deals with the design and construction of dressing plant, and excellent working drawings of specimen plants make the design clear to the readers. In fact, the illustrations all through the book are very helpful.

In our review of Richards's book we emphasize the fact that the literature of ore-dressing gets out of date so soon; the same remark occurs to us in connection with Louis' book, and we may instance the description of the Edison magnetic separator used at Dunderland. We are sure the author is as sorry as anybody that this plant has proved a failure. We may also say that Mr. Louis is not always impartial in his references. His description of the vacuum-concentrator at Dolcoath is quoted from a "pamphlet issued by the inventor," but as a matter of fact this pamphlet was merely a re-print of an article that appeared in a mining paper of repute, written from independent information supplied by the authorities at Dolcoath. It is a pity also that the historic process invented by Robson and Crowder should appear both in the text and in the index as Robson and "Cronader." But the book contains so much of value and is so well printed and illustrated that trivial errors of this kind will readily be overlooked.

E. W.

HYDRO-ELECTRIC DEVELOPMENTS AND ENGINEERING. — By Frank Koester. Cloth. 454 pp. 500 illustrations. New York: D. van Nostrand Co.; London: Archibald Constable & Co., Ltd. Price 21s. For sale by *The Mining Magazine*.

The application of electric power to mining purposes is a subject rapidly coming to the front, and in mountainous districts where fuel is scarce and water plentiful the hydro-electric system of generation is being widely adopted. There are two classes of such installations, one consisting of a cheap pipe-line and Pelton wheels or turbines sufficient to drive a plant of ordinary size, and the other the gigantic dam and high-voltage transmission. Eventually when electric smelting becomes widely applied to metals other than aluminium and when the present small beginnings in hydro-electric smelting of iron ore in Sweden have expanded, the question of hydro-electric generation will be even more widely studied. The present book deals chiefly with the big installation where electricity is generated in bulk and distributed among numerous consumers. It gives complete information about the various branches of the subject such as dams, head-races, penstocks, power-plant, electrical generators, transmission, sub-stations, and distribution. The practice quoted is by no means American and the author is particularly well equipped for dealing with European practice as well as American. Eight typical plants are described in detail. Of these three are in North America: (1) the Ontario plant at Niagara, with medium head and 60,000 volt transmission; (2) the Great Falls plant at Charlotte, North Carolina, with a low head and both 11,000 volt and 44,000 volt lines; (3) the Necaxa plant, in Mexico, with 1452 ft. head and a transmission line 160 miles long at 60,000 volts, an installation which is especially interesting because it supplies the mines at El Oro. Norway is represented by the joint plants at Kykkelsrud and Hafslund, 25 miles apart on the river Glommen and not far from Christiania, both being driven at low head. The installation at Urfttalsperre at the junction of the Urft and Ruhr rivers is taken as a notable German type with medium head; the price paid for current by the consumer is less than one halfpenny per unit. Another German installation is quoted, that at Uppenborn on the Isar, 33 miles below Munich, a low head proposition with 50,000 volt transmission. The Swiss-Italian station at Brusio in the Alps is operated by water at a head of 1300 ft. and the current is transmitted at 50,000 volts. Finally, the installation at Manojlovac, Dalmatia, receives notice, the special point of interest being that the current is generated at 30,000 volts. The book is beautifully printed, and it is made additionally useful by copious bibliographies at the end of each chapter.

DIE LAGERSTATTEN DER NUTZBAREN MINERALIEN UND GESTEINE, NACH FORM INHALT UND ENTSTEHUNG DARGESTELLT (Deposits of Useful Minerals and Rocks, arranged according to form, composition, and origin). Vol. I., Part I.—By F. Beyschlag, P. Krusch, and J. H. L. Vogt. Stuttgart: Ferdinand Enke. Price 7 marks.

The present volume is the first half of the first volume of a voluminous work, to be completed in three volumes. The second half will be published sometime during the autumn. Of the authors, Beyschlag and Krusch are members of the German Geological Survey, while Vogt is the distinguished professor at Stockholm. The current volume is introductory and contains the authors' classification of ore deposits. The book promises to be an important addition to the literature of the subject. German is a language not generally understood by English and American mining engineers, and we hope a translation of the present work will not be long delayed.

MODERN MINING PRACTICE.—By George Mitcheson Bailes. Five volumes, each about 250 pages. Ill. Sheffield: J. H. Bennett & Co. Price £2 12s. 6d. For sale by *The Mining Magazine*.

This book deals in an encyclopedic way with the practical details of coal mining, and provides information on theoretical subjects requisite for the intelligent study of underlying principles. It forms an excellent course of instruction for students desirous of qualifying for responsible positions in coal mines. The practice quoted is chiefly British, but Continental and American methods also receive attention. The author for 15 years was lecturer on mining to the Warwickshire County Council and is now principal of the Mining Engineers Correspondence School at Sheffield.

The first chapter deals with such branches of chemistry and physics as are of use to the mining engineer. The second discusses coal-dust, its dangers and prevention, and the third gases encountered in coal mines, also explosions and their results. Chapter 4 deals with methods of ventilation and describes various sorts of fans, and Chapter 5 discusses the theory of friction of air-currents in mine-passages. Chapter 7 describes different forms of safety lamps. The above chapters are all contained in Vol. I.

Vol. II includes chapters on conducting air to the working face, the removal of gas, mine-fires, breathing-apparatus, first aid to the injured, diseases of miners, geology applied to mining, explosives and blasting, prospecting and boring. Vol. III contains further chapters on boring, which is treated very fully and clearly; also chapters on modern methods of shaft-sinking under all sorts of circumstances and through all sorts of ground. Vol. IV deals with methods of developing and working coal seams, timbering, coal-mining machines, and rock-drills, while Vol. V treats of boilers, engines, electric machinery, winding, pumping, and hauling. Coal washing, coking, and surveying are mentioned, but very little information is given, presumably because these subjects are fully treated in other publications and are not strictly mining. The chapters on boring and shaft-sinking constitute the best parts of the books for the general reader.

MODERN PRACTICE IN MINING —Vol. II, The Sinking of Shafts. By R. A. S. Redmayne. Cloth. 8vo. 280 pages. Ill. London: Longmans, Green & Co. Price 7s. 6d. For sale by *The Mining Magazine*.

It is an unusual thing that three sets of books on one subject should make their appearance almost concurrently. This is what has happened in connection with coal-mining practice. Last year the Gresham Publishing Co. published a series of six volumes entitled 'Practical Coal Mining,' edited by W. S. Boulton, professor in University College, Cardiff, with the assistance of many experts in special subjects. This year a series of books entitled 'Modern Mining Practice,' by G. M. Bailes, made their appearance. The third set is that published by Longmans, Green & Co. with Mr. Redmayne as author. Of this series the first volume, entitled 'Coal: its Occurrence, Value and Methods of Boring,' appeared a few months ago. The second volume, which has just been published, deals solely with shaft-sinking. Subsequent volumes will treat methods of working coal, ventilation of coal mines, and the mechanical engineering of collieries.

It is inadvisable to make any general comparison of the relative merits of these three series of books, as they are all well done. Probably the sale of Mr. Redmayne's series will be enhanced by the fact that he holds the honourable position of Chief Inspector of Mines for the United Kingdom, but the chief reason that it appeals to us is the possibility of buying each volume separately. The other two series are only supplied in sets, and are therefore not readily saleable to engineers interested in metalliferous, as distinct from coal, mining. For instance, in Mr. Bailes's books the only part of direct interest to the gold miner is that devoted to boring and shaft-sinking, and these parts are not sold separately. Similarly Mr. Boulton's work contains an excellent chapter on 'Surveying' by L. H. Cooke, and as a separate book on surveying it would have a wide sale among School of Mines men. As it is, it is buried in a set of six volumes, which are not of special interest to the student of metalliferous mining. We therefore judge that the present book on the 'Sinking of Shafts' by Mr. Redmayne will have a large individual sale among mining engineers in general.

NEW PUBLICATIONS

THE RECOGNITION OF MINERALS.—By C. G. Moor, London: *The Mining Journal*. 230 pages. Price 7s. 6d.

Though called the 'Recognition of Minerals,' this book travels through the mineral industry in a general sort of way and is decidedly amateurish. From an advertisement at the end of the book it would appear that the author is more at home in the study of bacteriology and the purity of foods. His experience in mining was no doubt gained while he was resident chemist to the Ashanti Goldfields Corporation. The information is not up-to-date. For instance: "Sodium is made by Castner's process; it is used for reducing other metals and making sodium peroxide." As a matter of fact, the most profitable part of the Castner business is the application of the sodium to the manufacture of cyanide. The best part of the book is the preliminary section by Donald MacAlister on 'Rocks and Mineral Deposits.'

FLUORSPAR DEPOSITS OF KENTUCKY.—By F. Julius Fohs, being Bulletin No. 9 of the Kentucky Geological Survey. 296 pages, illustrated. Lexington, Ky.: The Kentucky Geological Survey.

The Kentucky fluorspar deposits are of importance to the American steel trade. In this bulletin, not only are these deposits described, but the whole subject of fluorspar, its occurrence, technology, and market conditions, are discussed with great fullness.

LIST OF MINES IN THE UNITED KINGDOM.—Prepared by His Majesty's Inspectors of Mines. Published for the Home Office by Wyman & Sons, London. 298 pages. Price 4s.

This government publication contains a list of all the mines in the United Kingdom at work in 1908, together with the names of the owners and managers, and the number of men employed both above and below ground.

THE TUNGSTEN ORES OF CANADA.—By T. L. Walker. 56 pp. Ill. Ottawa: The Department of Mines.

We cannot give higher praise for this work than to say that its quality is fully equal to the other monographs published by the Canadian Department of Mines under the general direction and editorship of Dr. Haanel.

ROYAL CORNWALL POLYTECHNIC SOCIETY, the 76th Annual Report of. Paper cover. 240 pp. Ill. Truro: Heard & Sons. Price 5s.

This volume contains many interesting papers, for example: 'The Tin Alluvials of Goss and Tregoss Moors,' by J. H. Collins; 'Tin in Bolivia,' by John Penberthy; 'Occurrence of Radium and Uranium in Cornwall,' by E. W. Newton, an abstract of which appears elsewhere in this issue; and 'Cassiterides and Ictis—where are they?' by Thurstan Peter, one of the most capable writers on Cornish archeology.

APPRENTICES COURSE OF EXPERIMENTAL PHYSICS AND MECHANICS —By James L. Maxim. 112 pp. Ill. London: Longmans Green & Co. Price 1s. 6d.

ANNUAL REPORT OF THE MINISTER OF MINES OF BRITISH COLUMBIA for the year 1908. 270 pp. Ill. Obtainable at the Agent-General's office, Salisbury House, London.

This volume contains the report on the progress of mining operations in British Columbia, submitted by W. F. Robertson, the Provincial Mineralogist.

REPORT ON THE INVESTIGATION OF AN ELECTRIC SHAFT-FURNACE.—By Eugene Haanel. Ottawa: The Department of Mines.

Dr. Haanel is already celebrated for his excellent reports on the electric smelting of iron ores published by the Canadian Department of Mines in 1904, 1906, and 1907. The present report contains 38 pages, three full-plate illustrations and numerous diagrams, and deals with the electric furnace in operation at Domnarfvet, Sweden. The investigation of the work of this furnace was done by Dr. Haanel in December 1908 at the invitation of the inventors. The report contains an account of the costs of producing pig iron by this process and some collateral information relating to the manufacture of electrodes.

CURRENT LITERATURE

Estimation of Copper in White Metal.—In the *Mining Journal* for September 4, L. Parry discusses various methods of estimating small quantities of copper (that is, less than 2%) occurring in white metal.

The Law of Fissures.—The *Bulletin* of the American Institute of Mining Engineers for August contains a paper by Blamey Stevens on 'The Law of Fissures.' The author discusses Becker's torsional theory of joints and holds that it fails to account for fissure fractures. It is generally assumed that joint-planes are fissures and faults in embryo, but the author argues that an entirely different law governs the formation of faults and fissures. This new law is stated thus : "In a homogeneous mass under pressure, slipping tends to take place only along those planes on which the ratio of tangential stress to direct stress is equal to the co-efficient of friction of the material sliding on itself."

Mechanical Sampling.—D. W. Brunton presented a paper on modern practice in ore-sampling to the Spokane meeting of the American Institute of Mining Engineers, in September. The paper deals with the standard Taylor & Brunton sampling system and gives the flow-sheets of the sampling works at the Tintic smelter, the smelter of the American Smelting & Refining Co., at Murray, Utah, and other places where this system of sampling is used.

The Assay and Valuation of Gold Bullion.—Frederic P. Dewey presented a paper on this subject at the Spokane meeting of the American Institute of Mining Engineers. The paper gives an account of the methods of assaying and valuing bullion offered for sale at the 11 purchasing establishments of the United States Mint.

Copper in California.—In the *Engineering and Mining Journal* for August 28, George A. Packard gives an article on the copper mines and smelters in Shasta county, California, the leading ones being Mountain Copper, Balaklala, Mammoth, Kennett, and Bully Hill. Most of this information has been published before, notably in articles in the *Mining and Scientific Press* by William Forstner and Donald F. Campbell, but the present article provides a convenient resumé of the subject.

Fluorspar in Colorado.—The resources of the United States in the matter of fluorspar have received much attention during the last few years, especially in Kentucky and Illinois. The resources of Colorado have more recently been investigated, and E. P. Burchard has reported on them for the Geological Survey. His paper is quoted fully in the *Mining and Scientific Press* for August 21. The localities where it is found in payable quantities are at Jamestown and Rosita. It has been used successfully by the Colorado Fuel & Iron Co. at Pueblo. Now that an import duty has been imposed, probably the whole of the requirements of the steel industry will be met by domestic supplies, instead of it being imported from England as hitherto.

Cyanide Practice.—In the *Mining and Scientific Press* for August 21, E. M. Hamilton, of the Butters Salvador mine, discusses the 'all-sliming' method as applied to silver ores. Though often claimed, he doubts whether any mill carries out the system in its entirety, and he gives good reasons why it is uneconomical to persist in reducing all the ore to a slime. His experience is that the best commercial results are obtained by reducing 70% to a slime and the remainder to a fine sand, treating the two products by agitation and leaching respectively. Probably the reason for failures in the leaching of the fine sand is the difficulty in effecting a complete separation of the slime from the sand and the consequent hindrance to free percolation. The author proceeds to give details of a separator which in his experience has given much cleaner charges of extremely fine sand.

Gold in Nicaragua.—C. C. Semple in the *Mining and Scientific Press* for August 14, gives some account of the mining conditions in the northeastern section of Nicaragua.

The Yampa Smelter, Utah.—Leroy A. Palmer in the *Mining and Scientific Press* for August 14, publishes an article fully describing the plant of the Yampa smelter in Bingham canyon, Utah. The capacity is from 1,000 to 1,200 tons per day. The ore is of uniform quality and in its crude state forms an excellent smelting mixture, its composition averaging 2% copper and 30% each of sulphur, iron, and silica. The coarse ore is treated in blast-furnaces and the fine in reverberatories. The blast-furnace charge consists of 4,000 lb. ore, 1,400 lb. lime, 300 lb. reverberatory matte, and 600 lb. coke. The slag is more silicious than the average, and contains 45% silica, 25% oxide of iron, 17% lime, and 6·9% alumina. The matte produced at present is low-grade, and tests are being made with a view to improvement ; in the meantime no figures relating to this point are published. The treatment of the fine ore consists of roasting in six-deck McDougalls in which the sulphur is reduced from 30% to 5%, the necessary heat being supplied entirely by the ore. The roasting is regulated in such a way that no fluxes need be added. The matte produced in the reverberatories is subsequently added to the blast-furnace charge, and the slag is so clean that it is thrown away. Mr. Palmer's article gives details of the construction of the various furnaces.

Nitrate Deposits of Chile.—Gilmour E. Brown in the *Mining Journal* for August 28 gives a long illustrated paper on the nitrate deposits of Chile, dealing with the occurrence, geology, and method of extraction. This subject is one on which there is very little literature in the English language, though papers and books in German and Spanish have appeared.

Cyanide Practice.—W. E. Simpson, in the *Mining Journal* for August 28, gives some details relating to the Chatelet gold mine at Evaux in the central district of France. The gold is contained in a fine state of dissemination through quartz and kaolinised matter, and the ore also contains 3 to 4% pyrite and 2% arsenical pyrite. The treatment is similar to that at Kalgoorlie, and the plant consists of rolls, ball-mills, Merton furnaces, tube-mills, agitators, and vacuum-filters.

Copper Smelting.—In the *Engineering and Mining Journal* for August 21, A. Rizo-Patron, of Huaraucaca, Peru, discusses the formation of ferric oxide and magnetic oxide in the pyritic process of smelting copper ore, the formation of oxides being suggested as the cause of failures in the process.

Tungsten.—The *Bulletin* of the Imperial Institute, Vol. VII, No. 2, 1909, contains the first section of a series of articles on the occurrence and utilization of tungsten ores.

Cyanide Practice.—Theodore P. Holt, in the *Mining and Scientific Press* for July 31, continues his dissertation, appearing in the issue of April 17, as to the activity of the cyanide solvents on silver sulphide ores in presence of other metallic and earthy materials.

Ferro-boron.—The *Mining and Scientific Press* for August 7 publishes an article by K. Iwai and J. C. Ballagh on the production of ferro-boron in the electric-arc furnace direct from iron ore and colemanite. This paper is the *Mining and Scientific Press* prize thesis presented to the president and faculty of the Colorado School of Mines, in June 1909.

Cyanide Practice.—In the *Mining and Scientific Press* for August 7, T. S. Lawlor describes an apparatus that reproduces in laboratory form the action of air-agitators of the Brown or Pachuca type.

Guatemala Mining Code.—In view of the increased interest in mining possibilities in Guatemala, facilitated by the extension of the railway from Mexico into that Republic, the *Mining and Scientific Press* for August 7 gives extracts from the mining code.

Measuring Stopes.—In May 1909, Otto S. Tonnesen read a paper before the Chemical, Metallurgical, and Mining Society of South Africa on a new instrument invented by him for accurately measuring stopes. Trouble has recently arisen on the Rand out of the dissatisfaction of the miners, who complain that measurements are made to their disadvantage. This instrument was invented with a view to securing greater accuracy.

Measuring Velocity of Gases Discharged from Smelters.—In *The Engineering and Mining Journal* for September 4, O. E. Jager and G. C. Westly describe the application of the Pitot tube for measuring the velocity of gases in chimneys. This apparatus is used for ascertaining the amount of deleterious matter discharged by smelters.

Northern Mexico.—In the *Mining and Scientific Press* for August 28, R. H. Burrows gives the first instalment of an article on the geology of Northern Mexico, more especially of the mining region (70 miles wide and 400 miles long) served by the Kansas City, Mexico, and Orient Railroad.

Sulphur in Mexico.—In *Mines and Minerals* for September, Edward F. White describes modern methods of sulphur mining in the southern part of the State of San Luis Potosi, about 18 miles from the Mexican Central station at Cerritos. These mines were formerly worked by the natives, but are now operated in a more systematic manner.

Geology of New Zealand.—In the February issue of the *New Zealand Mines Record*, James Park commenced a series of articles, not yet completed, on the geology of New Zealand.

Metallurgy of Copper.—In *Mines and Minerals* for September, R. L. Herrick describes the ore-bedding and charging systems at the Cananea smelter in Mexico. The ore-bedding was devised by A. S. Dwight and the plant for distributing and handling the ore by E. H. Messiter, who wrote an article on the subject in the *Mining and Scientific Press* for October 26, 1907. The new furnaces with improved charging apparatus were designed by Charles F. Shelby, who described them in the *Engineering and Mining Journal* for April 25, 1908.

Study of Diamond Ground.—In *Economic Geology* for August, Victor Hartog, for some time surveyor at the De Beers mine, gives the result of his microscopic studies of the diamond-bearing peridotite of Kimberley. The paper is made additionally interesting by the provision, by Alexis A. Julien, of a bibliography of the diamond fields of South Africa.

Phenomena of Folding.—In *Economic Geology* for August, Frank L. Nason discusses the folding of rock strata, dealing especially with the highly contorted sedimentaries found in the Rocky Mountains, where folding and fissuring are not accompanied with eruptives. He deduces theories that help to estimate the extent of fissures and the possibilities in connection with their mineralization.

Accuracy in Assaying.—In the *Mining and Scientific Press* for September 4, J. W. Howson discusses the accuracy of the usual commercial methods of assaying and analysis of ores, and gives a number of figures showing the average possible divergence in assays and check-assays.

Impounding Tailing.—H. W. MacFarren, in the *Mining and Scientific Press* for September 4, describes methods of stacking tailing on the hillside in such a way that the sand forms a dam and the slime is accumulated between this and the slope.

Relation of Costs to Profits. — In the *South African Mining Journal* for July 17, H. Musson Thomas, manager of the City & Suburban, revives the argument in favour of more accurate sorting out of waste before sending to the batteries, and publishes detailed specific examples bearing out the idea. The subject is further discussed by correspondents in the issues of July 31 and August 7.

Tranvaal Tin. — The *South African Mining Journal* for August 21 and 28 contains an important report by U. P. Swinburne on the economic aspects of the Waterberg tin district. In the same periodical for June 26, July 3, 17, 24, and 31, J. E. Mills-Davies contributes a series of articles on the tin districts of the Transvaal.

Settling of Mineral Grains.—In the *Engineering and Mining Journal* for September 11, Arthur O. Christensen discusses mathematically the phenomena of the different rates of hindered-settling of various minerals, especially quartz and galena. The calculations and investigations were made while the author was working with R. H. Richards.

Ore Dressing.—A paper by Rudolf Gahl in the *Bulletin* of the American Institute of Mining Engineers for September gives some account of experiments undertaken with a view of re-treating the slime-tailing at the Detroit copper mine in Arizona. Frue vanners gave the best results. They were tried with plain and corrugated belts and at different angles of slope and with other varying conditions. The results were not entirely conclusive, but none the less they are interesting.

Influence of Bismuth on Copper.—H. N. Lawrie, in the *Bulletin* of the American Institute for September gives an account of the influence of bismuth on wire-bar copper.

Arizona Copper Deposits.—In the *Mining and Scientific Press* for September 11, C. F. Tolman, jr., contributes an article on the geology of the Southern Arizona Copper region, referring especially to the recently disclosed deposits of chalcocite disseminated through schist, as exemplified at the Miami and Ray mines. The second part of this article appears in the issue of September 18.

165

The Mining Magazine

Vol. I LONDON, NOVEMBER, 1909 No. 3

Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.
PUBLISHED BY THE MINING PUBLICATIONS LTD., at 819 SALISBURY HOUSE, LONDON, E.C.

Issued on the 15th day of each month.

Telegraphic Address : Oligoclase. Telephone : 8938 London Wall.

BRANCH OFFICES : SAN FRANCISCO, 667 HOWARD ST. ; CHICAGO, 934 MONADNOCK BDG. ; NEW YORK, 500 FIFTH AVENUE ; MEXICO CITY, CINCO DE MAYO, No. 32.

AGENTS FOR THE COLONIES : GORDON & GOTCH, LONDON, MELBOURNE, ETC. (SOUTH AFRICA : CENTRAL NEWS AGENCY, LTD.)

Registered with the G.P.O. for transmission to Canada by Canadian Magazine Post.

SUBSCRIPTION RATES.

United Kingdom, 12 Shillings (Single Copies 1s.) ... ... Abroad, 16 Shillings (Single Copies 1s. 4d.)

CONTENTS.

REVIEW OF MINING

THE alacrity with which money has been subscribed to one or two recent flotations confirms the impression that there is plenty of English capital awaiting the opportunity of fructifying employment. Securities formerly issued have been assimilated; London is not heavy with undigested financial paper; on the contrary, there is a keen expectation, not excited but interested, of new openings for industrial expansion, particularly mining. West Africa promised for a while to afford an outlet for energies accumulated during a lengthened period of dullness, but the requirements of the limited mining activities of the Gold Coast have been met by South African capitalists and it now remains for actual work in the mines to justify this absorption of money before further expansion is justified. Mexico, Siberia, Colombia, and other regions are undergoing the selective processes of the mining adventurer, but at the moment there is no new mining district ready to meet the demands of the enterprising speculator.

Kaffirs have not exhibited the resilience anticipated by speculators for the rise; but this is not astonishing. Prices are high, quite as high as the dividends warrant. As the industry becomes established the shares lose in speculative flavour and become investments returning a small interest with the minimum of hazard to the principal. Assurance eliminates excitement, the stability of an investment dampens the pyrotechnics of a speculation. Even as investments their popularity has suffered from disappointment over the labour supply and from annoyance caused by the heavy death-duties imposed by the Transvaal. At the close of the month the Kaffir department received the benefit of several highly satisfactory reports, such as those of the Consolidated Gold Fields, and the Simmer & Jack. The former shows a noteworthy increase in profits, warranting a dividend of 35% for the fiscal year, as against 20% and 12½% respectively in the two previous years. But even this notable increase has been fully discounted by the share quotations. No less than £500,000 has been set aside nominally for depreciation in the value of investments but really to fortify the financial position of the company and to enable it to undertake new business, as it has lately done in West Africa and Rhodesia. Simmer & Jack pays 22½% for the year, as against 20% last year, and only 10% in each of the two years previous. This company draws £25,000 per annum from its freehold estate of 5200 acres in Germiston, a suburb of Johannesburg.

At the present time the profits earned by the mines of the Rand approximate £1,000,000 per month. The yield of gold from the Transvaal represents 35% of the total world output, the August statistics show that costs average 16s. 9d. per ton as compared to 17s. 4d. a year ago, and further reduction is assured. But the industry is overshadowed by the lack of an adequate supply of native labour. At every turn this difficulty makes itself felt, and we have reason to believe that it is even more serious than the big houses care to admit.

Further scarcity of labour on the Rand appears inevitable. The ease with which the Chinese were replaced was due to the closing down of De Beers, the famine among the native tribes, systematic and widespread recruiting, and shrinkage of Government work by reason of the financial depression. Now De Beers is in operation, there is less famine among the natives, the Government is starting more public works, and this last factor will be intensified because, by the terms of the Act of Union, the balance of money not spent by the individual States will go into the Union exchequer. Moreover, the natives prefer employment at surface, on railways and buildings, to work underground. The impending scarcity will be minimized on the big mines, which are well organized as to their labour supply; moreover, many of them can lessen the need of hand-labour by the increasing use of machine-drills. A notable expansion in the application of drills is already apparent and it will be accelerated. For the big widths of 'reef' this will be economical, but on the narrow seams of ore the substitution of hand-labour by machine-drills will mean the breaking of a larger proportion of waste and a consequent higher cost of extracting the ore. The new mines will feel the pinch. Of course, development work has been at high pressure during the last two years and it can be curtailed for a time. There may be no real hurt to the intrinsic value of the productive mines, but the conditions now developing will culminate in an outcry for more labour and a renewal of the demand either for Asiatics or for white workmen; in any event, the disturbance will depress the market by an intrusion of politics such as occurred in 1906.

Rhodesian shares are not yet investments, so that in that department the speculator can still get plenty of fun—and anxiety—for his money. More banket discoveries are announced. The increased mining activity has caused a drain on the supply of native labour.

From West Africa nothing startling is announced, but on the third level in Justice's mine the lode has now been proved for a width of 25 ft., yielding an average of fully one ounce per ton. In the Ashanti mine, also on the third level, the last 137 ft. has averaged 4½ oz. for about 5 ft., widening recently to over 5½ ft. This is excellent. Another cheerful bit of news relates to the Abosso mines where the lode has been cut on the No. 10 level, and assays 23 dwt. for a width of 31 inches. This also is most encouraging.

Our Melbourne correspondent sends several interesting items concerning Mt. Lyell. We may add that W. H. Twelvetrees, the Tasmanian Government Geologist, has been sent to examine the Zeehan district in consequence of Daniel Griffith's recent speech on the Zeehan Montana. Below 500 ft. the mines in this district are unproductive, the silver and galena contents dwindling, although the lode-channel persists, only to be filled with iron carbonate. In fact, Zeehan is a beautiful, but sad, example of secondary enrichment or primary poverty, the choice of terms depending upon the point of view.

The Waihi, the greatest gold mine in Australasia, continues to afford a cheerful example of persistence in depth. The 9th, and deepest, level is uncovering fine ore at 1003 ft. below the surface. The north cross-cut from the No. 4 shaft has cut the Martha lode and proved it 86 ft. wide. The quarterly circular issued by the management states that the first 30 ft. assayed 6s. 2d.; the next 30 ft., £5. 5s. 8d.; and the last 30 ft., £1. 17s. 2d. per ton. A drift westward has advanced 20 ft. in ore averaging £5. 10s. The ore contains silver as well as gold, hence the assays are stated in terms of currency. Winzes sunk from the 8th level have followed high-grade ore. On the whole, the evidence is most satisfactory and accentuates the splendid vitality of the Waihi. The output for September was 33,697 tons, yielding £75,852, or 45s. per ton. The dividend for 1908 was 85%; it is likely to be increased for 1909.

Another protest against the rise in the price of water furnished by the West Australian government was forthcoming at the Lake View Consols meeting, for the recent increase in the price means that the Government takes one third of that company's profit.

As regards Broken Hill, the issue of Amalgamated Zinc (De Bavay's) was six times over-subscribed and constitutes a most creditable flotation. The first unit of the new plant of the North Broken Hill Co. has started and the second unit is to be ready at the end of the year. Now about 4000 tons per week is being treated, but by January 1 the tonnage will be 6000 per week, with an anticipated yield of 3600 tons of lead and 1,000,000 ounces of silver per annum, from which a profit of about £100,000 is expected, taking lead at £13 per ton and silver at 2s. per oz. The report of the Sulphide Corporation is due shortly and ought to show handsome earnings, as both the new lead and the zinc plants have been in operation for nearly the entire twelve months. The zinc product from Broken Hill will shortly amount to 350,000 tons per annum, equal to 150,000 tons of metal, all of which is under contract to the members of the zinc cartel, a pool formed about a year ago and embracing the chief European metal merchants and smelters. Incidentally, this zinc concentrate will furnish a by-product of 5,250,000 oz. silver, enough to depress the market in that metal.

Copper mining in Siberia, chiefly in the Ural region and in Akmolinsk, is attracting increasing attention. The exploitation of copper in Russian territory is aided by an import duty of £32 per ton. This protects the operator by giving him the domestic market and an artificial price. Among the important enterprises is the Spassky, in the province of Akmolinsk. The ore in this mine is rich, if limited in extent. At 420 ft. a cross-cut has penetrated through 13 ft. of solid bornite carrying 50 to 55% copper. For a width of 20 ft. the average assay is 41%. On the level above, this orebody is 300 ft. long and averages 18% for a width of 20 ft. Beyond the limits of the high-grade ore the lode is poor and contains enough barite to impair the fusibility of the slag, necessitating an excessive quantity of flux. This obstacle is being avoided and other improvements in the smelting methods have been introduced lately by F. C. Knight. The production at present is 130 tons of copper per month, but this is to be increased shortly to 200 tons per month. Fairly good coal for the blast-furnaces is obtained in the vicinity. The Atbasar mine is in the same province and 220 miles from the Tashkent railway. Here the copper occurs as an impregnation of bornite and chalcocite in sandstone, resembling the disseminated lead deposits of Missouri, while at Spassky the ore replaces a slate near an intrusion of rhyolite. The Atbasar deposits are within 73 miles of coal and constitute a promising, but undeveloped district. Another British copper enterprise is the Kyshtim, in Perm, where large low-grade pyritic veins have been tested by diamond-drilling as well as mining. The latter is said to lag behind the smelter capacity. A recent report states that the plant will give an output of 5000 tons of copper per annum at a cost, including refining, of £32 per ton. The Kyshtim ore contains gold and silver, diminishing the cost of the copper produced.

Dredging for gold is likely to become prominent soon by reason of business under way in California. C. M. Rolker has been examining the Natomas property and reports $23,000,000 of profit assured, while W. P. Hammon is stated to have put the figure at $20,000,000. These estimates are big but the Natomas Consolidated is capitalized at $50,000,000, so that it will take a heap of gold to amortize the capital and yield adequate interest on the investment. The Natomas consolidation was incorporated a year ago and then controlled 6000 acres of dredging ground, on which 14 dredges were at work, as well as land and quarries. The capital stood at $25,000,000 in bonds and $25,000,000 in stock. E. J. De Sabla is the guiding spirit, although Frank Griffin engineered the consolidation. Another prominent stockholder is Louis Sloss, of the Alaska Commercial Co. W. P. Hammon is managing director. The dredging ground is near Folsom, Sacramento county, and near Oroville, in Butte county, California. It was estimated that the gravel would yield 10½ cents per cubic yard at a cost of 4 to 4½ cents per yard. Incidentally we are glad to say that the danger of interruption to operations by reason of opposition from farmers in the valleys below has been removed by a decision of the recent "anti-dredger" convention at Sacramento. A committee appointed by that convention, in September, after investigating the operations on the American, Yuba, and Feather rivers, reported that the dredges were doing "more good than damage" and that the "big boats" were "impounding millions of cubic yards of the sand and keeping it from coming down the streams." This finding is most important to the future of dredging in California.

The speeches made at the annual meeting of the White Pass & Yukon Railway have attracted attention to the mining industry of the extreme Northwestern corner of the American continent, to the development of which this railway has given notable assistance. Reference to the discovery of pay-ore in veins, as distinguished from placers, will excite interest, for no important gold-quartz lode is exploited to-day in the interior of either Alaska or the Yukon. The small operations on the Dome and in Victoria gulch, both near Dawson, give promise of profitable development, but much work remains to be done before that promise is confirmed on a large scale. Meanwhile fresh alluvial finds are announced from the Koyukuk. The last boat of the season has left Nome and the Northland is closed to all but the intrepid until next June.

It is stated in Mexico and New York that the Exploration Company has taken an option on the La Blanca, at Pachuca, but this is officially denied in London. The La Blanca adjoins the Santa Gertrudis, the latter covering a portion of the lode on the dip. We are informed, however, that the Exploration Company has taken an option on the La Reforma, at Campo Morado, in Guerrero. This is a large copper mine and has been examined lately by R. M. Raymond. Our correspondent informs us that the Mexican Light & Power Co. intends to extend its power-transmission line from Necaxa to Pachuca; this would ensure cheap power in that district. We note also that the Allis-Chalmers Co. has given, to the Cia. Beneficiadora de San Francisco y Pachuca, a quotation on Pachuca agitators to be built in the United States, and has guaranteed immunity against any claims for royalty.

From New York we learn that the long-deferred amalgamation of the Nevada Consolidated and the Cumberland-Ely copper mines has been effected, it having been arranged to increase the capital stock of the former by 400,000 shares in order to acquire the latter on the basis of 1 share of Consolidated for 3¼ of Cumberland-Ely. There was a rumour that the Giroux company, controlled by Cole & Ryan, of the Amalgamated and International Smelting companies, was in the market for Cumberland-Ely. Undoubtedly Cole & Ryan would like to control one half of the Steptoe smelter, for such an acquisition would be a thorn in the side of the American Smelting & Refining Co. and would give the Giroux a reduction works. Under the circumstances the Nevada Consolidated is probably well advised in absorbing Cumberland-Ely, and thus preventing an obvious chance of destructive friction. This amalgamation or absorption may be the precursor of others.

There is good reason to believe that an earnest effort is on foot to check the excessive copper production, which has depressed the price of the metal, and has become a gathering menace to the stability of the market. It is rumoured that the big producers of copper have agreed to diminish production by 20%, and that even Rio Tinto is a party to this agreement. Hence the better feeling recently. It is high time that the orgy of production was checked, for at the end of October the stocks of metal showed further increase, despite an increase of over 9000 tons in American consumption. On November 1 American stocks stood at 73,000 tons as against 64,820 in January, while in England and France the stocks were 90,000 tons as against 52,935 in January. Moreover, it is believed that reserves have accumulated in Germany and Holland. Obviously, if the 'cheap' copper mines now approaching the productive stage, in Arizona especially, are unhindered in their output, there is bound to be a collapse in the price of the metal. The industrial revival in America is a cheerful fact, but it has already been largely discounted by those invincible optimists on the other side of the Atlantic.

From the Indian mines comes only the news of steady operations. The treatment of the tailing at Dharwar Reefs still continues to cause trouble to the metallurgists and anxiety to the directors. It was only in September that an announcement was made relative to the solution of the difficulty. For some months the ore had been experimentally treated at the central metallurgical laboratory in the Kolar district, and it was supposed that a satisfactory process had been evolved. Accordingly the plant was reorganized on the new lines and operations were commenced in September. It is a matter of surprise therefore to hear that the new process is not coming up to expectations, and that it has become necessary once more to revert to experiments. Unfortunately the Dharwar Reefs company is running out of the funds subscribed at the reconstruction in 1908, and the amount of capital remaining in hand will have to be carefully husbanded. Unless the tailing treatment can be successfully modified within a few weeks it is probable that operations will have to cease at the mine and work centred on the tailing problem. As recorded last month, the developments at the mine have been discouraging and the ore reserves are exhausted. The unexpected failure of the new tailing plant alters the situation, and the question of continuing or abandoning the development will have to be seriously considered. The new find at the North Anantapur mine in the Madras presidency continues to open out well and is more persistent and regular than most orebodies found in this locality. Among the additional discoveries may be mentioned a lode 9 ft. 6 in. assaying 1 oz. 7 dwt. per ton and another 2 ft. 9 in. wide with 2 oz. 8 dwt. These discoveries make the prospects in the Anantapur district rather more hopeful. As regards the Kolar mines little can be added to our last review. The Mysore, Nundydroog, and Ooregum are the most regular producers, and Champion Reef is showing signs of increasing its output once more. The Nundydroog mine deserves special mention, for in all probability it will beat its own record during the current year. In the new Edgar shaft at the Mysore mine the rails for the cages and skips have been fixed to a depth of 1446 ft. out of a total depth of 2500 feet.

We refer elsewhere in this issue to the notable expansion of the oil industry in many directions, notably South America. On the Ivory Coast of West Africa and in Nigeria there is active exploration for this useful mineral. The Société Francaise de Petrole is prominent in this connection, as is also the Nigeria Bitumen Co. It is interesting to note that a moribund Australian company purposes to revive its energies by speculating in the Black Sea oil region and there is ample confirmation of the news concerning a gusher at Maikop, 50 miles from the port of Tuapse, to which a pipe-line is to be constructed. This oilfield has also attracted the Lake View Consols, which, like several other exhausted bonanzas, is perpetuating itself by acquiring new interests. Among these are oil-lands in Russia, Trinidad, and Peru. Exploration for oil is proceeding in Madagascar, which is under the French import duty of 90 francs per ton. We have also heard of successful drilling near the San Juan river, in Utah.

EDITORIAL

THIS MAGAZINE is issued on the fifteenth day of each month. It was found advantageous to publish on this date because of the number of other periodicals appearing on or about the first day of the month. Contributions addressed to the Editor should be in his hands by the end of the previous month.

AT OUR REQUEST Mr. Horace G. Nichols describes his device for removing slime as it settles. The subject is important to many of our readers and for that reason we urged the inventor to give an account of an invention in which many obscure principles are involved. Mr. Nichols has given a description in which the free settlement of ideas, by rapid separation from turgid thought, is amply illustrated. The article on the Cobbe - Middleton pan is by Mr. Edward Walker, our assistant editor.

WILLIAM GOWLAND has been awarded the gold medal of the Institution of Mining and Metallurgy, "in recognition of his services in the advancement of metallurgical science during a long and distinguished career." An alumnus of the Royal School of Mines, a successful metallurgist, and the professor of metallurgy in his Alma Mater, it was most appropriate that Mr. Gowland should receive this, the highest professional award, on vacating his chair as professor. From many quarters we have heard expressions of keen pleasure that the Institution should have bestowed the medal so worthily. The Professor may have been retired by reason of an arbitrary age limit, but his many friends are delighted to recognize that nature, more kindly than the Government, has placed no such restrictions upon his continued usefulness as a teacher, a scientific observer, and a technical adviser.

SAN FRANCISCO has been celebrating her recovery from the earthquake-fire of April 18, 1906, and from every quarter of the globe she has received enthusiastic congratulations. As one of the participants in her misfortunes and her reconstruction, we join in the chorus of goodwill. Whatever other features San Francisco may exhibit, she challenges wonderment for astonishing vitality and indomitable pluck; she can lift her face to the blue Californian sky and give thanks for an unconquerable soul. And yet we marvel not so much at the expression of truly American energy as at the persistent resourcefulness and sustained courage of a community that is rotten to the very core with municipal and financial corruption. San Francisco has withstood the heavy hand of calamity; can she conquer herself? Apparently not, as would appear from the municipal election on November 2, which indicate the defeat of the reformers.

IT IS ANNOUNCED that the gold medal donated by the Consolidated Gold Fields of South Africa and awarded annually by the Institution of Mining and Metallurgy, has been given to Mr. W. A. Caldecott "in recognition of his work in the investigation of methods of reduction and treatment of gold ores, and of his contributions to the literature of the subject." This is an appropriate award, for Mr. Caldecott is the chief metallurgist in the employ of the Consolidated Gold Fields and he has done splendid work in the cause of science as applied to cyanidation on the Rand. But we confess to particular pleasure in the secondary and conclusive reason for the award, namely, because "of his contributions to the literature of the subject." The "investigations of methods" may be useful to the man who makes them and to those for whom he makes them, but the value of them is restricted within narrow limits until they become translated into "contributions to the literature of the subject." Mr. Caldecott's work would have gratified his employers, in any event, and would have given satisfaction to himself, in any case, but he has been among the few possessing a large mind and a generous impulse, causing him to give the benefit of his researches to his professional brethren all over the world through the medium of technical publications. He exhibited the laudable ambition to become known as an efficient metallurgist; he showed an enlightened spirit in his desire to help others by publishing the details of his work. We congratulate Mr. Caldecott on the fact that his services to the profession are appreciated.

Stope Contracts.

A large proportion of the ore mined on the Rand is broken under contracts with the miners. Of late this system has aroused antagonism among the contracting workmen because they object to their dependence upon estimates based upon the hasty measurements of a mining company's official. Dissatisfaction and suspicion have tended to cripple a system that under favourable conditions is both efficient and equitable. The local Press at Johannesburg has recently ventilated this question of contract measurement; columns of correspondence from miners and hypothetical surveyors have been published, and a confusing mass of testimony has been offered. It is noteworthy that allegations of wilful manipulation of the surveyor's figures are more frequent than suggestions of inaccurate measurement through carelessness or incompetence. Other accusations, many of them extravagant and reckless, have been made in print, but no real constructive criticism has been preferred. Undoubtedly, the miner would be glad to receive a big cheque, in which event he would be pleased to postpone indefinitely the discussion of the ethics of the case; but in default of a solution so simple, the best way to obviate trouble is to allow new measurements to be made by an independent surveyor and to simplify the procedure involved so as to minimize misunderstanding. This arbitrator, however, would be dependent to some extent upon the data furnished by the mine office, so that the workmen might not be wholly satisfied even with such a safeguard. At several mines it is now the custom to plot the stope-faces on squared paper, each square representing one fathom—the unit of measurement on which the contracts are based. Thus, it is claimed, the miner can see his stope-plan and can readily count the fathomage due to him. But undue emphasis on this method as a solution of the difficulties involved is misleading; to do so is to trifle with the serious question at issue. No miner suspects that the error or falsification occurs in the measurement of the area on the plans, whatever his opinion of the planimeter's capabilities for deception. If, distrusting the declared measurement, he counted the fathomage squares and found them correct, he would still have cause for uneasiness. From his point of view, the attitude of the official mine-surveyor resembles that of the professional conjurer, who, to prove that the rabbit, glass of water, Union Jack, and billiard balls really were produced from the "empty" hat, and to demonstrate conclusively that there was absolutely no deception, allows any member of the audience to come on the stage and inspect the articles revealed. No hocus-pocus will eradicate suspicion and the friction arising therefrom; what is wanted is fair dealing between employer and employee.

Practical Geology.

Our esteemed contemporary at San Francisco makes complimentary reference to the retirement of Mr. A. C. Lane, the State Geologist of Michigan, and refers in appropriate terms to his valuable services. These we also desire to honour. Mention is made of the other geologists that have done useful work for the Michigan Survey, but the name of L. L. Hubbard is omitted. This omission we venture to remedy, for Mr. Hubbard, while State Geologist, proved the practical and immediate value of geology to mining by a discovery of far-reaching importance. The story is worth re-telling. The Kearsarge lode, a persistent bed of copper-bearing amygdaloid, had been worked profitably in the northern part of the Keweenaw peninsula, made famous by the Calument & Hecla mine, but it had not been traced south of Houghton. Hubbard noticed that the foot-wall of this amygdaloid was marked by large feldspars, and he utilized this fact in his search for a southward extension. By careful observation of the stratigraphy of the region, particularly the relation between the beds of conglomerate and amygdaloid, he obtained the clue necessary to intelligent exploration. At a distance of about 100 feet east of the Kearsarge amygdaloid there is a bed of conglomerate, which being less susceptible to weathering is apt to show a bold outcrop, while the amygdaloid and trap beds are so easily subject to erosion as usually to be covered with drift or detritus. Placing these facts in their proper relation, Hubbard began a systematic search. On the moorland belonging to the St. Mary's Canal Mineral Land Co. he found a solitary outcrop of conglomerate, which he was able to identify as paralleling at about 100 feet the copper-bearing bed, and finding at that distance a depression between two outcrops of trap, he sunk prospect-holes, which disclosed rock rich in native copper. This marked the discovery of the Baltic lode and the beginning of the Champion mine, as well as others on the same strike, giving Michigan a number of richly productive copper mines. There never was a better example of the scientific application of geology to mineral exploration. No roster of the Michigan Geological Survey is complete without the name of Hubbard.

Chemistry applied to Mining.

The popular interest in radium and radio-activity has prompted amusing displays in journalism, pseudo-science, and jointstock finance. A subject so recondite provokes the ignorant to prophecy and the simple to credulity. It is the alchemy of our day. From alchemy came chemistry; from the study of radium and its manifestations may be developed a bio-chemical science of the greatest utility to mankind. But not yet. In the meanwhile the subject serves to illustrate the pitfalls that await the scientist who becomes a participant in commercial enterprise. Sir William Ramsay is prominent in connection with the British Radium Corporation, which is a concern formed to produce and sell radium to be extracted from the pitchblende to be found in the Trenwith mine in Cornwall belonging to the parent company, the St. Ives Consolidated Mines. The public has evinced an interest in the undertaking by subscribing for or otherwise acquiring the shares, which now stand at a premium owing to the demand for them. This demand is attributable in a large measure, we believe, to the sanguine expectations imputed to Sir William Ramsay, who was much in evidence on the occasion of laying the foundation stone of a laboratory at Limehouse, where the pitchblende is to undergo treatment. A picturesque ceremony, graced by the presence of ladies, gave a pleasing touch to this inauguration of a "new British industry." But the public, whose imagination is stirred by these functions, is not informed how much pitchblende is available, nor as to its radium contents, nor other facts essential to commercial success. We venture to doubt whether the production of radium can be regarded as a sound commercial proposition, because the sources of the element are limited, the amount likely to be extracted is infinitesimally small, and when obtained the uses for it are ill defined. As yet, apart from its value as a scientific curiosity, the only application of radium is in the higher branches of medical science, where new forces are being commandeered for the tentative mitigation of diseases of obscure origin. Such utilization of the elements existing in rare earths may appeal to our humane instincts and the studies made by specialists may prove extremely interesting, but the state of knowledge in this field of enquiry is so nebulous that we cannot view with satisfaction its exploitation for purposes of commercial enterprise. Therefore we deprecate the prominence given to Sir William Ramsay. Of course, we understand that he has been retained on account of his familiarity with the subject of rare elements and of the work done by the Curies, in particular, but while we are willing to accord him the highest respect as a specialist in this branch of chemical research, we are unable to speak in the same complimentary terms of his knowledge of practical mining, or of the business-like consideration necessary for the attainment of financial success. It is a truism that scientific investigators and academic expositors are not well fitted either to apprehend or cope with the engineering difficulties and business conditions incidental to industrial chemistry and metallurgy, and it would be well if those scientists who disregard this axiom could appreciate the risk they run of finding themselves placed in a false position, such as Sir William Ramsay doubtless felt himself to be in connection with the Gold Extraction & Bromine Recovery Company, an undertaking formed for the purpose of applying a new process, which although favourably reported on both by Sir William Ramsay and another equally eminent authority in the person of Sir William Crookes, failed lamentably as a commercial scheme. It is folly to assume because a scientist takes a keen interest in a theoretical problem that he is the man to advise on its commercial possibilities. Such assumptions, if acted on, usually end in a pitiable fiasco. The advice of engineers and industrial chemists not only affords security to the public purse, but generally assists in the achievement of success.

Mining in the Far East.

We publish an article by Mr. Thomas T. Read, professor of mining in the University of Tientsin and a mining engineer of experience. Recent events in the Far East renders this contribution particularly timely. Early in September an agreement was concluded between China and Japan whereby the latter was given the exclusive right to work the Fushun and Yentai mines during the term of the lease held by the South Manchurian railway. The other coal mines within the railway zone are to be worked by Japan and China conjointly. Last year the minister of Communications planned to introduce the Fushun coal into Japan for use on the Government railways, the difference in cost between this fuel and the Japanese coals representing a saving of over 1,500,000 yen per annum. This event, of course, disturbed the Japanese coal market and led to an arrangement renewing the contracts with the Japanese coal companies at a reduced price, and allowing the principal coal operators of Japan to acquire an interest in the Fushun company. It must be remembered that the coalfields in Japan are limited in extent and the threatened depletion of them by heavy exports for the shipping trade has aroused alarm in Japan. Now the shipping trade will be largely supplied from Fushun. Moreover, Korea is without coal suitable for fuel and the deforestation of the country by its natives has produced such a scarcity of wood as to check industrial development. By the importation of coal from Manchuria the Japanese forestry department expects to protect the timber and bush of which a large part of Korea was being rapidly denuded.

These arrangements between China and Japan caused uneasiness at Washington, the State Department regarding the concession to Japan as a violation of the pledge of an 'open door.' It was expected that Mr. Charles R. Crane, the newly appointed minister to Peking, would take the matter in hand on arrival in China, but he talked indiscreetly and exhibited such lack of diplomatic sense that early in October he was recalled to Washington and requested to resign. It is hoped that the appointment vacated by Mr. Crane and offered previously to Mr. Hammond, as well as to Senator Fulton, will be filled by a man able to combine discretion with sagacity. At a time when Americans are interested in the industrial expansion of the Orient it is unfortunate that the United States should be unrepresented at Peking, and it must be allowed that the President has been curiously maladroit in allowing the appointment to be refused publicly by so many men, and of such mixed qualifications. For both Messrs. Fulton and Crane were peculiar selections, while Mr. Hammond, well equipped as he is for diplomatic finance, was so close to Mr. Taft as to make us wonder at the necessity for a public declination of the post. It will be found that our correspondents at Tientsin and San Francisco both refer to these matters.

Nor are English interests unscathed. It will be remembered that the Chinese government cancelled the concession held by the London and China Syndicate in the province of Antui. This concession was secured several years ago by Sir John Lister Kaye; it included iron and copper mines, on which £50,000 was spent in development; but the "China for the Chinese" cry was raised and by a compromise it was arranged that the mines should be worked by an Anglo-Chinese company. The Chinese government refused to sanction this arrangement, whereupon the English Syndicate offered to accept £296,000 in 5½% bonds. In reply the Government offered £50,000, although it is claimed that ore of the value of £836,000 had been proved. The matter came before the House of Commons in August, and is in process of adjustment, with such deliberation as is appropriate to Oriental diplomacy.

Professional Solidarity.

On October 27 the prospectus of the Spanish Mines Consolidated was published in the financial Press. In this prospectus we find quoted the reports of three engineers to whose names are affixed a significant assortment of letters in the form of M.I.M.E., A.M.I.C.E., and A.R.S.M., indicating that the bearer has affiliations with recognized technical institutions. But not one of these three engineers signifies his membership in the Institution of Mining and Metallurgy, for the letters M.I.M.M. are conspicuously absent. Thereupon the question arises as to whether this omission is a reflection on the engineers or on the Institution. We insist that it must reflect on one or the other.

So far as we know the three men mentioned in the prospectus are properly qualified practitioners and the absence of their names from the roll of the Institution does not indicate unfitness for the duties of a consulting mining engineer. There are enough other men similarly situated, as to aloofness from the Institution, to prevent us from making inferences unfavourable to the three men in question. Then we find ourselves compelled to assume that there is here a reflection on the Institution as a completely representative organization. This reflection is inevitable, but it is not deserved, and it ought to be removed. We hold that the Institution has done enough good work and has won enough general support to be regarded as the nucleus of the mining profession in Great Britain and the Overseas Dominions. Without disparaging other societies elsewhere, it is not too much to say that the organization now firmly established in the British metropolis and supported by the leaders of the mining profession in the Empire has a claim on all of those engaged as specialists in the exploitation of the useful metals. Every mining engineer should ask himself why he is not a member; if not yet qualified by age or experience, he should look forward to becoming qualified; if qualified, he should ask himself again why he has failed to become enrolled. It is either his fault or the Institution's; if the latter, let him remedy the defect by becoming a member and by taking a proper part in the proceedings. We need a rallying point, an organization, a society capable of strengthening the solidarity of the profession. The Institution is trying to perform this function, and successfully. Of course, it is far from perfect, and to some of its imperfections we drew attention in our last issue. But the remedy is neither icy isolation nor sulky solitariness, but co-operation.

Speculative Fever.

Among the contributions appearing in this issue is an interesting account of an engineer's experiences in 'Hunting for Mines in Mexico.' The article is written by Mr. W. A. Prichard, an engineer with experience in California and Western Australia. Men who go "hunting" for mines adopt diverse tactics, as sportsmen do when in quest of big game. The story of the successful search for profitable forms of mining enterprise is full of romance—a romance of variegated character, in which honest skill and slippery chicanery are inextricably blended. Mexico has been the arena of many queer performances and the scene of much enlightened enterprise. Among the great mines of the present day several are in that portion of Spanish America and of these a reasonable percentage are in the hands of Englishmen.

Undoubtedly there are many persons in London who would like to know how to find new opportunities for the lucrative employment of their capital in Mexican mines and to them Mr. Prichard's account will prove suggestive. He dwells upon the periods of speculative intensity that have successively given an impetus to the search for mines and a hysteric violence to the gambling in mining shares. With much that he says we agree, but we demur to his diagnosis of the conditions that ensued in the first two or three years of the 20th century. He credits to Mr. Curle and to Bewick, Moreing & Co. the results that we are disposed to impute to agencies of a more general character. The abatement of the speculative fever between 1901 and 1905 was due to the fact that a number of mining enterprises went wrong, coincidently; the Rand was in poor odour, several of the big mines at Kalgoorlie were pinching out at depth, at El Oro the prospects were blue, the Tomboy and the Camp Bird looked sick in their lower levels, and generally the outlook was gloomy in a large number of representative undertakings. In 1906 the tide of sentiment turned, the gold discoveries at Goldfield, the copper developments at Ely and Bingham, the reduction of costs on the Rand, the intersection of the Esperanza bonanza, the silver finds at Cobalt, the promise of Cerro de Pasco, Tanganyika, Poderosa, and Copper River, Alaska, the proved persistence of the Great Boulder lode at Kalgoorlie—all these had a cumulative effect in re-awakening a cheerful optimism that culminated in the brief boom of the past summer, with the promise of further expansion in the near future.

Undoubtedly Mr. Prichard is correct in advising the purchase of promising prospects in preference to developed mines. The latter method involves large sums of money and is dependent for success upon so many unascertainable factors as to be most risky when it seems least dangerous. Of course, ore reserves assure prolific production, for a time at least and possibly long enough for the creation of a lively market in the shares, but we are discussing a subject from the standpoint of legitimate business, not frenzied finance. On the other hand, the life of a prospect is as uncertain as that of a baby; it takes a clever man and a lucky one to appraise the futures of either. But the big money in mining has been made by buying young mines, nursing them, developing them, until they have grown to full maturity as assured enterprises. One of the best examples of this procedure is the Miami copper mine, in Arizona, where a young mine was purchased for \$100,000 in cash and \$150,000 in \$5 shares at par. The enterprise was capitalized at \$3,000,000 in 600,000 shares, of which 200,000 were set aside for working capital and \$100,000 was spent in development before an issue was made to the public. Exploratory work was so satisfactory and proved such an extent of ore that the \$5 shares rose to \$15 soon after the flotation, and have been considerably higher more recently. This episode occurred last year and suggests that the sport of mining still affords opportunities to the adventurous.

The Advertiser as a Censor.

The gaiety of this metropolis gained appreciably during October by the controversy between the *Westminster Gazette* and Mr. George Edwardes. A typical *entrepreneur* wrote to the editor of the leading evening newspaper to threaten the withdrawal of all his theatrical advertising because a dramatic critic had commented adversely on a musical comedy. Whereupon the editor published extracts from the threatening letter and delivered himself of some straight talk, which was followed in the course of a few days by letters of approval sent by Messrs. William Archer, George Bernard Shaw, and other dramatists. At the same time Mr. Chiozza Money wrote a letter heartily endorsing the attitude of the editor and emphasizing the degradation of English journalism by its subserviency to advertisers.

This episode is of more than passing interest, and by analogy throws so strong a light on the relation of technical journalism to the advertising of machinery that we venture to make a few remarks. Mr. Edwardes put his own ideas in a nutshell when he said: "It appears to me to be an anomaly to advertise in one column and to be attacked in another." Mr. Shaw suggested that Mr. Edwardes should "charge himself with the remuneration of" the dramatic critic of the paper in which he advertises. Mr. Money said that "the theatre is the least important of the branches of industry as to which it is sought to make editors consult their advertisement managers before they dare put pen to paper." He also said: "Modern papers are sold to the public at a price which means a heavy financial loss unless there is a big advertising revenue. The public do not 'buy' papers at all; the papers, economically, are given to the public by rich advertisers." Hence the censorship of the Press by advertisers like Mr. Edwardes. For our part, viewing the daily Press of London with the mental detachment of the man in the street, we note that a book is reviewed in a newspaper if the publisher of the book advertises in that paper, the interest of the book to the readers of the paper becoming a secondary factor; hence the second-hand book-dealers receive books sent to the Press for review and find the pages of them uncut. The reviewing of books is regarded as a trade operation. A type-writing machine is commended in one column and the reason for such commendation is seen in the advertisement appearing in an adjacent column. It is not too much to say that even the best papers — the best in our language — are vitiated, if not corrupted, by the sinister influence exercised by the advertiser upon the editor. As a warning, illustrating how far this tendency can develop, we have the daily Press of the American cities, notably San Francisco, where the plunderbund of predatory finance has dragged a subservient Press into the very mire of corruption by methods that differ from those we have deprecated only in degree. There the newspaper depends for its revenue upon the enormous advertisements of the 'dry-goods stores'; these are under the thumb of the banks, from which they obtain their working capital; the banks are controlled by captains of industry and *chevaliers d'industrie*. Thus in the end the American daily Press, which is the only mental pabulum of the larger part of the adult population, has become the slave of corruption in finance and politics.

Let us return to the "anomaly" of Mr. Edwardes. Evidently he regards an advertisement as a sop to Cerberus, as a means for purchasing immunity from unfavourable criticism; but the sauce for his goose is not necessarily the sauce for another's gander. He does not perceive the obvious result that if honest criticism were to be gagged by advertisements, the value of any dramatic criticism in the Press would decline below zero. Further, a critic that is servile to an advertiser becomes malicious to him who refuses to advertise; in plain English, we see the seeds of blackmail. The problem may be approached from two directions, that of the reader, who is the chief concern of the editor, and that of the advertiser, to whom the publisher looks for his financial support. Obviously the readers look to the editor not only to entertain them with interesting information but to protect them from mis-information. They trust him, as we trust the editor of *The Spectator*. When they find that they are deceived, that the reading matter is used as a lure for advertising, as a means of surreptitious puffs, or an underhand device for expressing personal antipathies, they withdraw their support. If they live in a community where all the papers are alike subject to subventioning processes, they choose the paper that is least infected, and hope for the day when their local journalism shall have grown to literary manhood. To the advertiser it is important that his announcement shall reach the persons likely to become his customers. If he deals in quackeries he will do well to advertise in the class of paper attractive to simpletons; as a vendor of get-rich-quick schemes he will find the gutter Press an admirable aid to notoriety; as a manufacturer of good machinery and a purveyor of high-class products he will discover that the best papers are the most efficient vehicle for displaying his wares, because such papers are read by the men likely to purchase the material he has for sale. Anything that lessens the trustworthiness of the reading matter decreases the efficiency of the paper as a medium of publicity.

Deep Leads.

The recent meeting of the Australian Deep Leads Trust marked the obsequies of an ill fated series of enterprises in the State of Victoria. In 1904 half a dozen companies were organized in London to exploit buried river-channels analogous geologically to the 'deep leads' of the Forest Hill divide in California. This kind of alluvial deposit has yielded much gold both in America and Australia; indeed, the Madame Berry at Creswick, near Ballarat, ranks among the great gold mines of the world, for until it was recently closed-down by exhaustion, it yielded 387,351 ounces of gold, worth £1,588,515, from which were paid royalties amounting to £128,317 and dividends aggregating £855,450. And all this was done on a paid-up capital of only £15,975. That is something like mining! At least, it affords a sad contrast to the deep lead enterprises to which we advert. These were part of the wreckage left by the collapse of the Whitaker

Wright flotations and represented an earnest effort to retrieve the blunders of that irresponsible promoter.

From geological inference it was ascertained that a system of buried gold-bearing channels existed, and bore-holes proved the depth and direction of them. An American geologist of the highest repute was engaged to report; he expressed the most favourable opinions. Several companies started to sink shafts to bedrock and to pump the water stored in the old valleys, now covered with lava or detritus. Then the trouble began. The drainage of the ground became a long and costly operation in most cases, and proved impracticable in others. The resources of the most up-to-date pump manufacturers were utilized and the best available skill of specialists in this class of work was applied, so that finally the Loddon Valley ground was drained, permitting access to the gravel deposit. The yield of gold was disappointing, for the distribution of the metal was patchy, so that the average output was only 8 dwt. per fathom. Allowing for amortization of the capital expended in sinking and drainage, about 15 dwt., or twice the yield, was required. Of course, operations were discontinued, but not before the lead had been thoroughly cross-cut and adequately tested. Meanwhile the neighbouring companies on the Charlotte Plains, Moorlort, and the Victorian Deep Leads had been sinking money and extracting water until a thorough test could be made in a typical case, such as was provided by the Loddon Valley. When that was demonstrated to be a failure the others ceased further effort and went into liquidation. Only the Berry United remains active and even this solitary survivor is evidently making water in greater ratio than gold, the yield of 43,399,533 gallons contrasting with 544 oz. per month. The average is 18 dwt. per fathom or barely enough to keep the enterprise above water. The 'lead' has proved narrower than was estimated.

Thus closes an interesting chapter in mining; it bears the record of financial courage and technical skill, but these factors were vitiated by an incurable optimism, of which it is fair to say that it is neither discreditable nor foolish, but essential to mining adventure. In making a post-mortem it will be well to point out one lesson, namely, that the geological vision was not translated into mining realization because the geologist made his inferences without sufficient data on two essential points; the distribution of the gold and the pressure of the water in the deposit. Roughly, the gold was diluted with too much water. In this case the opinions of mine managers familiar with living in the locality were as much at fault as the dictum of the scientific observer imported from a distant country. The Victorian Government granted £20,000 toward the cost of pumping and successive State geologists expressed views favourable to the venture. Thus no one can pose as a prophet. But many may draw a moral. The worst of all waste is the waste of experience.

The Labour Problem.

Since 60 to 65% of the cost of winning the useful metals is represented by the money paid in wages to workmen, it is obvious that the labour problem is fundamental in the economy of mining. Hence the communication from Mr. W. J. Loring will be read with care by other mine managers eager to ascertain any fact or opinion useful in their business. Mr. Loring speaks from a background of wide experience, fully warranting the positive character of his statements. "The proper study of mankind is man"; this motto should hang in every mine manager's office; it is the duty of the engineer in temporary command of human beings to get an intelligent understanding of their wants and desires, in so far as these affect the purpose for which other men are placed under his orders. "Man's inhumanity to man makes countless thousands mourn"; a mine manager's inconsiderate or blundering treatment of his employees has made hundreds of shareholders sad, when by stupidity or ignorance the workmen have revolted against the measure meted out to them, becoming silently disaffected or going into the violent protest of a strike, the economic result of which has been to increase the cost of mining and to reduce profits to the vanishing point.

The labour problem is a subject as wide as humanity and as basic as the crystalline schists; it is not intended on this occasion to discuss more than one question raised by our contributor. He argues that the only cheap labour is that which is efficient, and to make workmen efficient it is necessary to offer them encouragement. He does not believe in a minimum wage, which, in effect, sets a fixed limit to the workman's earning power and thus tends to discourage those possessing more than ordinary skill and energy. In other words, what matters is not the amount paid to the miner but the quantity of ore he breaks in the stope or the number of feet he advances the drift. Some managers are obsessed with the narrow idea that it is their duty to make men work for as little as possible, and to such men a coolie or a convict is the ideal labourer. They keep their eye on the pay-roll rather than the balance available for dividends. On the contrary, the really thrifty manager takes for his unit not the day's wages but the day's output, he cares less for the figure representing the money paid to workmen than for the result of their work. What matters it whether the miner gets 8 shillings or 12 shillings per diem if the cost of breaking the ore is less with the higher priced labour than with the cheaper? We have in mind an instance in Colorado where after the silver panic of 1893 the rate of day's pay was reduced successively from \$3·50, to \$3, and then to \$2·50. Yet the cost of mining was not reduced proportionally; the best men migrated to localities offering higher wages, and the labour employed in the silver mines was recruited from the coalfields and the farms of the Middle West. The only corrective was to introduce the contract system, whereby skill and persistence were compensated. Thus the average pay was raised to \$3 and the best men got \$4 or even \$4·50; when they did, no attempt was made to cut down their earnings by unfair contracts; the mining company was gaining from their harder work and greater skill, so that the cost of stoping, driving, and cross-cutting was being reduced. The company shared with the men in the benefit accruing; it was an example of co-operation.

In his example, taken from Western Australia, Mr. Loring exhibits the application of the same idea. It is a truism that cheap machinery is, in effect, expensive; it should be equally recognized that under-paid labour is an inefficient machine. This applies as much to the Korean or the Chinese as it does to the American or the Englishman. The management of men should be such as to encourage them to special effort and exceptional skill. As applied to the higher races this is appreciated; as a rule applicable to the dark-skinned peoples it is usually disregarded. There is more extravagance in the use of the coolie than in the employment of the artisan. In mining as in other forms of human industry it is necessary to gauge cheapness by productiveness.

The Avio.

In arranging the details of the transaction whereby the Camp Bird company acquires the Santa Gertrudis mine, at Pachuca, it ha been found necessary to overcome an obstacle to the legal completion of the purchase. This obstacle is one that is not at all uncommon in the case of old Mexican mines. We refer to the *avio*, a contract of lease, whereby the holder or *aviador* obtained the virtual control of the mine. At Guanajuato, Pachuca, and other old mining centres, the Spanish operators exploited rich silver veins before the revolution, which in the early years of the nineteenth century ended the Spanish domination, and long before the Anglo-American industrial invasion, which subsequently induced a peaceful evolution in mining and metallurgical methods. In the early days of Mexican development the mines were usually exploited not by their owners but by parties who secured a lease in perpetuity, termed an *avio*, which gave the lessees or *aviadores* the right to do what they pleased in the mine and to make contracts for the disposal of the ore. The *aviadores* charged, as a lien against the mine, all expenses incurred, such as development, operation, taxes, and plant. Against these charges they credited the net returns obtained from the sale of the ore, but, being able to dispose of it wherever they pleased, they built *haciendas*, or reduction works, on their own account and then made agreements for the treatment of the output, mixing ores of varying richness so that the yield could not meet the treatment charges. Thereupon, as the owner, by the terms of the *avio*, was not entitled to a centavo unless there was a balance to credit, he never received anything; thus a constantly increasing debt accumulated. This debt finally grew to an impossible sum, so that, in effect, the *aviadores* became the real owners of the mine. For example, the group of mines acquired in 1904 by the Guanajuato Reduction & Mines Co. was saddled with an indebtedness of 6,000,000 pesos, most of which was entered against four properties, namely, the Rayas, Mellado, Cata, and Valenciana. This debt was incurred nearly 50 years ago. In 1860 the Señora Perez Galvez, then head of the house Rul, began a clever campaign, the purpose of which was to obtain *avios*, or perpetual leases, on this group of mines. By the terms of the *avio* she was enabled to charge all expenditures against the mines, crediting them only with the money received from the sale of the ore; by building reduction works or *haciendas*, she made contracts with herself to purchase the output, deducting high rates for treatment and mixing the rich with the poor ore, so that the expenses of mining were always in excess of the yield and steadily increased the debt against the mines, while permitting of handsome profits at the *haciendas*. Thus she obtained legal control of these properties. The American company bought these *avios*, the debt to the Rul family becoming payable to the new owners; the company thereby inherited all the old contracts, including the agreement for ore-treatment: it did not incur any obligation to pay the former—almost nebulous—owners of the mines unless the profits from the sale of ore to the reduction works first paid the debt and its accumulated interest. In this case the contracts were based upon an old scale of charges, it being specified that 360 grammes (or 12 ounces) per ton was to be deducted from the yield of the ore, the remainder to be paid for at the rate of 3 centavos per gramme; and the yield of gold up to 6 grammes per ton to be paid for at the rate of 30 centavos per gramme; between 6 and 15 grammes, the payment to be 45 centavos. As the average ore of this group of mines contains 350 to 400 grammes of silver and 3 grammes of gold per ton, it is obvious that the *aviadores* would escape an accounting.

It is generally accepted in Mexico that the *aviadores* are the unquestioned owners of the mines to-day and no court can invalidate their peculiar rights. Attempts have been made to break the *avios*, but they have failed. In the case of an English corporation, to which these rights were transferred, it would be necessary to form a milling company separate from the company operating the mine, but subsidiary, and then agreements could be effected between the mill-company and the mine-company, so that the new owners would be fully protected. Thus does an anachronism resist the advance of modernism; conquered it survives, to remind the operator of to-day that he incurs the liabilities of predecessors long since departed.

Responsibilities of Directors.

Divided opinion in regard to the responsibilities of the directors of a Rhodesian company that were dilatory in giving information to their shareholders, affords a text for comment. In this case the directors are, we believe, above suspicion of having profited by the delay; the postponement of publication of news from the mine being due mainly to the desire not to mislead by giving inconclusive data. It so happened that speculators in London were kept informed by an agent in the mine itself and made a profitable deal in the shares before the report from the mine was issued. This fact gave a sinister interpretation to the delay in publication and incited criticism not entirely warranted. We refer to the Globe & Phœnix; a similar episode has occurred even more recently in the case of the Sheba mine.

The old question therefore arises: What is the duty of the management in a case of this kind? If discrepant assays are cabled, the shareholders are likely to be misled; if they are not announced promptly, the agents of speculators utilize the opportunity to play the market. Apparently, the directors have to choose between the two horns of a dilemma. At Kalgoorlie during the boom of ten years ago it was the custom of the Adelaide and Melbourne brokers to have agents among the miners in order to secure the first news of any important change in the condition of the mine. This scheme confused the directors—at least, those of them who were not in the game—and created a scandal, from which good eventually resulted. The new managements adopted a policy of prompt publication and full publicity in all their operations; they forestalled the stock-jobbers, and gave the shareholders immediate news affecting the value of their property. Cablegrams were sent frequently and posted forthwith on the bulletin board at the company's office. That, it seems to us, is the only practical remedy. Of course, the assays of the ore in the face of a drift may vary from day to day so much as to bewilder the untechnical man, and the abnormally high or low assay obtained when a vein is first intersected in a cross-cut or a winze may prove deceptive if taken at its face value, but as the inference is made by each man for himself, he can only blame himself if it prove wrong, and unless he is a timid speculator, he can await the conclusions of the mine manager, who ought to give his deliberate report as soon as the evidence suffices. If the directors and the manager unite in treating the shareholders as the real owners of the mine (and that is what they are) and if they will regard themselves as trustees with a personal responsibility to those shareholders, then there will be no difficulty in doing what is right. To those who play the market—buying or selling shares with every breath of gossip or whisper of development—to them the directors owe no responsibility. They are not the owners of the mine, they merely use the mine as a counter in gambling. Such ephemeral interest as they may happen to possess does not permit them to claim the directors as their representatives and does not warrant them in expecting the consideration due to the implied contract that does exist between the directors and the shareholders of persistent record. We distinguish between the duty owed by a director to the shareholder that elects him to safeguard his interests, and the purely temporary relation of the management to the stock-jobber who buys and sells within the period of a stock-exchange account, or carries a block of shares from one account to another, as counters in a gamble.

Oil Production.

The oil industry has a bearing upon metal mining in other ways besides such propinquity as is illustrated in California and Colorado, where wells producing oil are near neighbours to shafts reaching gold ore. Modern invention has facilitated the economic use of oil as fuel; in regions destitute of coal and wood, the importation of oil has made possible the use of machinery; and even as a competitor, oil has tended to displace steam, owing to its greater efficiency as a source of energy. The calorific ratio of average coal to average liquid fuel in pound of weight is 1 : 1·46, or, to make another comparison, the calorific ratio of good average coal in loose lumps weighing 49 pounds per cubic foot and liquid fuel of equal grade weighing 54 pounds per cubic foot is 1 : 1·615; while the ratio of bulk between these two forms of fuel is as 1 : 1·1. Again, the evaporative value of good coal is from 8 to 10 pounds of water from and at 212° F, while the equivalent for a liquid fuel is 13 to 16 pounds of water.

During the last two years the oil industry of the world has undergone extraordinary expansion. Apart from the extension of the California oil region, especially in the Coalinga district, it appears now that the oil-bearing formation of the Californian coast extends along the western shore of South America. Important discoveries have been made along this belt in Ecuador and in Peru. The London & Pacific Oil Company is now producing about 10,000 tons per month in Peru, and the Lobitos Oilfields is winning a rapidly increasing supply, besides numerous smaller concerns that are actively prospecting along the Peruvian and Ecuador coasts. A recent telegraphic despatch announces successful borings in southern Chile, between the Chilos and the mouth of the river Maullin. Another development of far-reaching importance has taken place on the island of Trinidad, off the opposite coast of South America. In consequence of the geological surveys made by the Trinidad government it has been ascertained that reservoirs of oil exist underneath the asphaltum district made famous by the lake from which the world has received so much paving material. It has been demonstrated that the asphaltum is the residuum from oil that has dried on rising to the surface. Large stores of oil exist underneath; these coincide with anticlinal axes of which several have been traced across the island, and all of them—on preliminary prospecting — appear to be oil-bearing. It will be noted that Trinidad is the nearest oil-exporting port to Europe and it is fortunate in having both ready access and cheap freight to the European markets. Moreover, Trinidad is a Crown Colony and the local government is inclined to encourage exploration, retaining the right to buy the oil for naval purposes.

In the Far East additional oil-bearing territory has been found in Burma, and a number of new companies are in the field in opposition to the former monopoly of the Burma Oil Company. An increase of output is therefore expected. On the Persian Gulf some of the largest flows of oil ever known have been obtained from wells that promise to yield a continued supply. The island of Ceram, in the Dutch East Indies, has been proved to be oil-bearing, and extensions have been found to the Borneo and Sumatra oilfields. Thus, news comes from many directions indicating that the oil industry of the world appears assured of notable expansion and of a geographical distribution so wide as to affect the choice of fuel for generating power, especially on sea-going vessels.

PERSONAL

ROBERT ALLEN, lately in Mexico, has gone to the Rand.

F. K. BORROW has returned to London from Manchuria.

R. GILMAN BROWN has gone to examine the Kyshtim copper mines in Siberia.

L. N. B. BULLOCK passed through London on his way from Mexico to West Africa.

J. PARKE CHANNING was in the Globe district, Arizona, during the past month.

R. H. CHANNING has arrived in New York from Cerro de Pasco, Peru.

ROWLAND FEILDING has joined the firm of Hooper & Speak.

E. NELSON FELL sailed for New York on October 27, and will reside in Virginia.

W. E. GORDON FIREBRACE is expected on his return from Peru.

R. J. FRECHEVILLE is making a flying trip to New York.

ROBERT HAWXHURST is expected in London from Chile.

HENRY HAY returned to Johannesburg early in October.

JOHN HAYS HAMMOND has been touring with the President of the United States.

C. A. HEUSSLER is examining mines in West Africa.

W. C. HOLDEN has gone to Johannesburg.

NICHOLAS HOLMAN has been appointed manager of the Gibraltar Consolidated mine in New South Wales.

ERLE HUNTLEY is now manager for the Hampden Cloncurry Copper Mines, in northern Queensland.

C. B. KINGSTON, of Pearse, Kingston & Browne, is expected in London on his return from a holiday in Canada.

NEWTON B. KNOX was in Hungary during October.

A. H. LAWRY has obtained an appointment in Nicaragua.

THOMAS H. LEGGETT was at San Francisco recently.

ERNST LICHTENBERG has an office at 3 Great Winchester Street.

D. A. LOUIS has returned from Saghalien.

CHARLES LUSH is in Northern Nigeria.

C. H. MACNUTT is superintendent of the Poderosa Mine, in Chile.

T. BRUCE MARRIOTT sailed on October 29 for the Argentine.

E. T. McCARTHY has returned from the Spassky copper mines, in Siberia.

CHARLES J. MOORE has opened an office at Denver.

C. ALGERNON MOREING went recently to Maikop, in the Black Sea oil region.

C. H. MUNRO has returned from Nome, Alaska, to San Francisco.

RICHARD PEARCE now resides at South Kensington.

ARTHUR L. PEARSE is at Juneau, Alaska.

ERNEST V. PEARCE has been appointed metallurgist to the Transvaal Consolidated Lands Co.

W. PELLEW-HARVEY and E. NELSON FELL have dissolved partnership; the name of the firm is now Pellew-Harvey & Company.

H. A. PIPER, consulting engineer to the Consolidated Gold Fields of South Africa, and to the Globe & Phœnix Co., in Rhodesia, has lately been confused with another Mr. Piper, now in West Africa.

H. A. PRINGLE has opened an office at Calcutta.

C. W. PURINGTON is expected on his return from the Okhotsk region in eastern Siberia.

R. S. RAINSFORD has been recuperating in Scotland and has now returned to California.

HOWARD D. SMITH, of San Francisco, is in France.

C. H. STEWART is on his way from Tasmania to London.

A. ERNEST THOMAS is on his way to southern Brazil.

H. A. TITCOMB has returned to London from the Ural region, Russia.

R. A. VARDEN, of Bainbridge, Seymour & Co., has left Colombia and is now in Brazil.

GEORGE BLAKE WALKER, of Bainbridge Seymour & Co., went to Canada on October 16 to examine coal properties.

W. H. WEED and FRANK PROBERT are examining mines at Guanajuato, Mexico.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

LIMA.

The Cerro de Pasco smelter is now producing at the rate of 50,000,000 pounds of copper per year. The September production shows over 4,000,000 pounds; the maximum daily output has been 164,350 pounds. Between 1000 and 1100 tons of ore are smelted per day in the four blast-furnaces and four reverberatories; the fifth reverberatory is idle owing to lack of calcines, of which 100 to 110 tons are treated daily per furnace together with 40 tons of flue-dust. The shortage of calcines is due to the lack of sufficient capacity in the McDougal roasters, of which additional units will be erected within a few months, so that by next summer the output will be on the basis of 60,000,000 pounds of copper per year. The shipment for July and August totalled 7,381,000 pounds. At the mines, the Central shaft recently completed and equipped (present depth 600 ft. although hoisting of ore is from the 400 ft. level and above) has already displaced three shafts and the fourth, 3600 ft. distant, will soon follow suit. The hoisting arrangement has been well planned: two compartments, for skips each of 5 tons capacity, separated by a manway; a fourth compartment (14 ft. long), solely for the cage carrying men, drills, steel, etc., and accommodating full-length timbers loaded in cars. The cage-landing is level with an adit that leads out to the central machine and carpenter shops. The cage is run in balance. This arrangement of the hoisting plant allows for continuous delivery of ore to the hopper-shaped bins, which discharge into railroad-cars. At present there are 158,000 tons of ore on the dump, equivalent to slightly less than half a year's smelter-supply. There are 12,000,000 tons of low-grade silver ore 'blocked out,' upon which experiments are being made as regards economical treatment.

Now that the boundary question with Bolivia has been definitely arranged, and gold is being imported, the past months of stagnation in business should be removed and better times result.

Vanadium. — The American Vanadium Co. with mines situated 45 kilometres west of Cerro de Pasco, Peru, is reported as contemplating the construction of a narrow-gauge railroad to the Cerro de Pasco railroad station at Unish, a distance of 30 kilometres; a surveying party is now in the field. It is stated that the mine workings show a net profit of £16,000,000 (?) in sight. The average ore, *rizopatronite* (a sulphide of vanadium) contains 25% vanadic acid, and serves as a fuel; the ore is roasted before being shipped to Pittsburg, U.S.A. The entire output is controlled by the United States Government. Another discovery has been made in the same region, but no definite result is known as

yet. The high price quoted for vanadic acid has stimulated the prospecting for vanadium. The asphaltic coal, occurring in various districts of Peru, contains vanadic acid in the ash; the investigation of these as a possible commercial source is being undertaken.

Morococha. — The consolidation of the Morococha Mining Co. (a subsidiary interest of the financiers controlling the Cerro de Pasco Mining Co.), the Backus & Johnston Co. (an American Corporation), and the Peruvian Mining, Smelting, and Refining Co. (a subsidiary interest of the United States Smelting, Mining, and Refining Co.), which has been under consideration by the respective companies for some time, is likely to be definitely arranged. The combination will result in increasing activity at the Morococha and Casapalca mines and will induce the reopening of many small mines in the vicinity.

The Morococha Mining Co. has the advantage of controlling a large tonnage of 6 to 11% copper ore, carrying a little silver. Probably it would prove more profitable to ship to the Rio Blanco smelter of the Peruvian Mining, Smelting, and Refining Co., than to the Cerro de Pasco plant, obviating a longer haul for the ore and the return haul of the resulting copper. The Backus & Johnston Co., operating mines at Casapalca and Morococha, and an out-of-date smelter at Casapalca, would be benefited in having its ores more economically treated. At Casapalca the principal vein has been opened up for 2½ miles and to a depth of 1700 ft., yielding low-grade copper ore but an appreciable silver content, persistent throughout the various workings. The Peruvian Mining, Smelting, and Refining Co. controls a copper mine (of limited tonnage) and other claims in the Morococha district. Its chief asset is the Rio Blanco plant. This smelter was erected in 1908; the furnace is modern and of 300 tons capacity; the ore was subjected to 'pot-roasting,' obtaining a 50% desulphurization and a sintered mass well suited for blast-furnace smelting. The plant was erected to do custom work, besides treating the company's own ore. Aside from the unfortunately large unit established prior to the assurance of a production sufficient for continued operations, the ore from the mine was not thoroughly analyzed, so that when smelting began there was trouble in getting a good slag. It was then learned that the constituent in the ore labelled as 'insoluble' was in great part alumina, requiring a charge of different components. The furnace ran about two months (September to November 1908) producing 750 tons of matte assaying between 30 and 40% copper and 40 oz. silver per ton of 2000 lb. This was shipped to the United States. The plant is 49 kilometres southwest of Morococha, 19 kilometres from Casapalca, 205 kilometres from the Cerro de Pasco smelter, and 135 kilometres east of Callao, the nearest seaport. All these places are on the railroad. The situation of the Rio Blanco is decidedly favourable to the combination proposed. It is probable that converters will be added and other changes made to the smelter, should the pending negotiations be concluded satisfactorily.

Gordon Firebrace, from London, has been examining the copper deposits at Ferrobamba, 70 miles south of Cuzco, and reports that these surpass Cerro de Pasco in magnitude. He is now on his way back to England.

SAN FRANCISCO.

The American Mining Congress at Goldfield (September 27 to October 2) was well attended and much interest was shown in the discussions. Several addresses dealt with the silver question, but nothing came of it except the appointment of a committee to investigate the relations between the price of silver and Oriental trade. It is interesting to note that here in Nevada, the home of the 'free silver' movement a few years ago, free coinage as a remedy for existing evils was not even seriously urged. J. H. Richards, who as president for successive years, has done much to hold the Congress together, retires and is succeeded by E. R. Buckley, a mining geologist of distinction. Other changes include the election of D. W. Brunton as director; on the whole, the Congress seems to be making good progress toward a position of real influence as a forum for the discussion of non-technical questions relating to mining.

Conservation: Interest in such problems is keen at present and has been stimulated by the addresses delivered by the President of the United States in the course of his Western tour. At Spokane, the scene of the celebrated Ballinger-Pinchot controversy, Mr. Taft gave a carefully prepared address announcing his policy as regards conservation. This was anticipated with much interest, for while Mr. Taft had sustained Mr. Ballinger and, indeed, eulogized him, he also praised Mr. Pinchot and announced himself a firm friend of conservation. Mr. Taft's policy involves the continued protection of the forests, and the temporary withdrawal from settlement of water-power sites, coal lands, oil lands, and phosphate lands pending Congressional action. He proposes that the law governing the sale of these lands be modified so as to (1) separate surface from mineral rights; (2) value the land according to its probable yield or (in the case of power-sites) return on investment; and (3) reserve them for lease or sale subject to restrictions designed to prevent monopoly. Mr. Taft disclaims any authority or responsibility other than to recommend action to Congress and is evidently a stickler for legal forms. In this he differs from his vigorous predecessor Mr. Roosevelt, who was wont to act when action was needed and leave to subsequent generations the debate as to his exact legal authority.

The American Institute of Mining Engineers has been visiting various mining districts in Montana, Idaho, Washington, Utah, and Colorado. At Spokane a joint session was held with the Western Branch of the Canadian Institute, and at the same place D. W. Brunton delivered his presidential address. This was excellent. Space forbids more than one brief quotation: "Heretofore it has too often been considered that an engineer's accountability ended when he discharged his full duty to his employer. Today we are beginning to realize that the public forms a third party, vitally concerned in the results of the work in which mining engineers are engaged. As large investments are usually held by divided ownership and stocks are often scattered far and wide, so that the owners of small holdings have little or no opportunity to become conversant with the exact conditions of the properties they represent, an engineer's first duty should be to see that no word or act of his can be construed so as to give one man an opportunity to take advantage of, or mislead, another."

The welcome given to the Institute at Salt Lake City was especially cordial. The Salt Lake of today is very different from the mining centre as it was first known to Dr. Raymond and other pioneer leaders of the Institute, and every opportunity was given the visitors to see the great mines, mills, and smelters in the vicinity. The management of the Boston Consolidated was especially frank in giving details and inviting criticism, and distributed a pamphlet giving exact costs for the month of September, when 7178 tons (dry) of ore were produced from the sulphide mine by square-setting at a total cost of \$1·68 per ton, 71,880 tons from the porphyry mine by caving at a cost of 66·7 c. per ton, and 72,000 tons were milled at a cost of 50·11 c. per ton. From this ore 3550 tons (dry) of concentrate containing 1,569,000 lb. copper were produced. The heads averaged 1·58%, and 21·8 lb. copper per ton of crude ore was recovered. It will be recalled that in this mill ore is crushed with the Nissen stamp. At the neighbouring plant of the Utah Copper Co., rolls and Chilean mills are used.

Goldfield, Nevada.

At Goldfield, Nevada, a peculiar accident occurred on September 25. The ground above the Hampton stope caved, carrying with it the cyanide vats and part of the structure of the Combination mill. The stope was 280 ft. below the surface and the ground between was supposed to be solid. When, therefore, the ground was observed to be working on the fifth level, no serious danger was apprehended. It seems, however, that the fractured rock above the stope had become saturated with water from a ravine crossing the property. The alunite along the fracture planes became soft and slick as a lubricant, with the result that a round plug of material approximately 300 ft. diam. dropped, leaving the surrounding rock firm. Three men working on an upper level were caught. Every effort was made to rescue them, a drift 35 ft. long being driven in 36 hours, but to no avail. One man was found standing at the head of the drift with his arms folded, dead by suffocation; the others presumably were crushed. It speaks well for the accuracy with which surveys are maintained even in these old workings, that the rescue opening exactly hit a small prospect drift, which in many mines would not have been on the map.

The Goldfield Consolidated continues to prosper. In the Clermont shaft large bodies of ore are being developed at 860 ft., several hundred feet below the old workings; whether an extension or not is uncertain. Fifteen railroad cars of this ore averaged 75·12 oz. gold per ton and nine cars, 91·12 oz. per ton of ore. The new mill is working satisfactorily and is to be enlarged by the addition of 40 stamps to replace the wrecked Combination mill. Amalgamation has been discontinued, the ore going direct to the cyanide department.

Tonopah also has reason to rejoice in recent developments. It will be recalled that the bonanza orebodies have heretofore been found only in what J. E. Spurr named the 'earlier andesite,' which is cut off by a fault above and an intrusion below. Attempts at the Mizpah mine to find ore in the lower formation were a failure. At the Montana-Tonopah, however, a second series of later veins has been discovered; these traverse both the andesite and the rhyolite without change in richness, so that stoping is now proceeding in both formations. The new ore, being more oxidized, at first produced complications in milling, but these have been overcome. The recent report of this company affords a creditable showing when the high cost of supplies and the extremely numerous faults cutting the orebody are taken into account. Both Charles E. Knox, the general manager, and Edgar Collins, the superintendent, are to be congratulated. Total costs are given as $9·94. Of this, $5·80 is for mining and $4·13 for milling. If these figures seem high it should be remembered that the scale of operations is small and difficulties numerous. For example, to follow the ore the drifts must be so numerous that, despite a cost of but $6·56 per foot, the cost per ton for development is $1·64, and to this must be added nearly a dollar for underground handling of ore. Tonopah is prosperous. The West End is building a mill and the tone of the camp is distinctly optimistic.

TORONTO.

Cobalt.—Shipments of ore from Cobalt camp showed a slight falling off in September, the total amount being 2505 tons, as against 3049 tons for the corresponding month of last year. Every previous month, excepting August, has shown a substantial increase, the total for the first nine months of the year being 23,116 tons as compared with 17,027 for the corresponding period of 1908. Last month's list was headed by La Rose with 620 tons, Nipissing taking second place with 422. A noticeable feature is the scarcity of new productive mines. A number of properties have been mentioned from time to time as likely to ship ore, but their promise lacks fulfilment. While 71 properties in the district are reported as in actual operation, employing between 3500 and 4000 men, the regular shipping mines are few in number, and of the 25 mines on this season's list several have shipped intermittently, some making only one or two consignments. A more encouraging indication is the payment of dividends for the third quarter of the year, amounting to a total of $1,328,531 by seven of the leading companies. Including bonuses, Nipissing paid 7½%, Crown Reserve 11%, La Rose 4%, Kerr Lake 6%, Buffalo 8%, and Right of Way 6%, while the Temiskaming and Hudson Bay with its unusually small capitalization returned $3 on each $1 share. The total amount paid in dividends and bonuses by these seven companies is $10,242,247.

Kerr Lake.—The annual statement of the Kerr Lake Co. for the fiscal year ending August 31, shows net earnings of $1,129,047 on an average monthly output of 227,387 oz. silver, being a total yield of 2,668,648 oz. This was produced from 1072 tons of ore averaging 2489 oz. and 600,000 lb. of screenings. The cost of production, including development, shipment, and treatment, was 12·38 cents per oz. Dividends during the year amounted to $480,000. The Silver

Leaf property has been leased to the Crown Reserve adjoining for a term of five years subject to renewal for a similar term. The Crown Reserve is to pay a royalty of 25% on the output for the first 5-year period, to be increased to 35% should the lease be renewed. The Crown Reserve further agrees to spend $20,000 in development for the first year and $10,000 in each of the next four years. A new vein has been struck on the Silver Leaf at the 100 ft. level. It is 5 in. wide and the ore extracted runs about 5000 oz. per ton. The Waldman continues to improve, the vein at 68 ft. yielding 5000 oz. ore. A vein on the Beaver, which faulted after yielding about half a car of high-grade at the depth of 200 ft., has been recovered by sinking a winze for 50 ft. The Right of Way has secured a controlling interest in the Cobalt Merger and will advance money for immediate development.

The Rush to the Klondike in 1898.

Yukon.—Alexander Henderson, Commissioner for the Yukon Territory, reports that the gold production for the fiscal year ending March 31 reached a total of 217,350 oz., valued at $3,260,263, an increase of $440,000 over the preceding year. The royalty collected was $81,507. He looks for a steady increase in the gold production of the Territory, as the completion of a water system by the Yukon Gold Co. will enable it to begin hydraulic operations on a large scale with seven dredges and three hydraulic elevators. Individual miners have also had considerable success and work on the quartz veins leads to the belief that this form of industry will become an important source of wealth.

New Districts.—The known silver-bearing area is being steadily extended by exploration. Considerable progress has been made in the exploration, by the officials of the Department of Mines, of the portion of the Gillies timber 'limit' lying south of the small area recently sold. The local geology has been outlined and found to be similar to the formations at Cobalt, giving the hope that it may also be rich in minerals. The South Lorain district is promising. On the Wettlaufer property, samples assaying 8000 oz. silver have been obtained. On the Newman property, adjoining the Haileybury, a good surface find has been made of a vein 18 in. wide in places and rich in native silver. One of the most important of recent strikes was the finding of a wide vein yielding native silver at the depth of 125 ft. on the Red Jacket, two miles south of the town of Cobalt.

At Gowganda good progess is being made by four or five companies, though operations have been delayed by difficulty in getting machinery. At the O'Kelly mine an important strike was recently made at the surface, and a test pit yielded several sacks of high-grade ore. The vein is about 3 in. wide at a depth of 8 ft. and has been traced for 450 ft. At the Bartlett, cross-cuts at 100 ft. have exposed new veins. Similar conditions appear in the Boyd-Gordon. The road from Elk Lake to Gowganda, now under construction by the Government, will hardly be ready before spring and meanwhile the camp is greatly handicapped by the lack of transport facilities.

Elk Lake.—There has been quite a rush to the Meteor river, about 16 miles southeast of Gowganda and eight miles from the Canadian Northern Railway Extension. The formation is diabase traversed by numerous calcite veins. Hundreds of claims have been pegged and development work is being pushed. Satisfactory reports come from the Elk Lake district; on the Gavin Hamilton property a 6 in. vein with a good showing of native silver has been found on the surface. The Lucky Godfrey, Delvin, and other mines are being developed. The shaft of the Big Six, in which good ore was found at 165 ft., is being sunk to 200 feet.

Royalties.—A question that excites much interest is the Government royalty, to which a number of the Cobalt mines are subject. It is claimed that the percentage of 25% of the gross output, which is the figure in most cases, is too high to permit of a fair return to the stockholders, and strong pressure for relief from the burden is being brought to bear on the Government. Among the mines that will benefit should the royalty be reduced, as is probable, are the Right of Way, Townsite, Nancy Helen, Cobalt Station Grounds, Railway Reserve, Jack Pot, and O'Brien. The Ontario Department of Mines has announced another sale of mining lands on the Gillies limit. A strip of land 1200 acres in extent immediately south of the properties recently sold, is offered for sale in 20-acre lots by tender. Bids will be received until November 15. Sales will be subject, as in the former case, to a 10% royalty on the output and to working conditions. Nine hundred acres of the 'limit' have already been sold and after the sale now pending 61,900 acres of this tract will remain in the hands of the government.

Reported discoveries of gold in paying quantity in Whitney township, near Night Hawk lake in northern Ontario, have been followed by a rush of prospectors. The provincial Department of Mines has sent James Bartlett to the district to make a thorough investigation.

Fluorspar.—Geologists of the Canadian Survey have obtained valuable specimens of fluorspar, stated to be superior to any hitherto discovered in North America, in Madoc township, Hastings county, Ontario. They are of a beautiful sea-green colour. Some fine samples of celestite have also been found in Lansdowne township, Leeds county, Ontario.

The Department of Mines has announced another sale of mining lands on the Gillies limit, near Cobalt. Bids will be received until November 15.

TIENTSIN.

Coal Competition.—At present the main feature of mining activity in the Far East is the competition between the Chinese Engineering & Mining Co. and the Fushun Mining Co. for the coal trade of the China coast. Until the appearance of the Fushun mines as producers the Chinese Engineering Co. had the field almost to itself, with Japanese coals as a poor second. But when the Fushun mines began putting out their coal of high calorific power, low ash, and low moisture, there was a quick change. The Chinese Engineering Co. cut its prices to meet those of Fushun, and the affair has settled down to a war on the basis of relative merits. In this the Engineering Co. has an advantage in that the Fushun coal needs entirely different treatment in firing, and when it is used on grates intended for other coal and is stoked in the same way, it will necessarily prove unsatisfactory. An amusing story is told to illustrate the prejudice and stupidity that a new product has to overcome, to the effect that one steamer filled its bunkers with Fushun coal and when it was a little way out of port put back again, asserting that the coal made too hot a fire and was burning the boilers. Apparently the only real point that can be made against this coal is that it is so free-burning that it is difficult to bank fires with it.

The importance of Fushun coal is a matter of more than mining interest; it has also its international aspect. Formerly Japanese coals supplied all the needs of Japan, and were also sold extensively along the eastern coast of Asia. While this was a source of trade to the Japanese producers it was equally a source of alarm to Japanese statesmen, for the coal resources of Japan are far from inexhaustible, and it might easily happen toward the end of the century that Japan, engaging in a war with China, would find herself in the unfortunate position of depending on the country with which she was at war for a supply of coal for her battleships. But the possession of the Fushun mines, estimated to be able to furnish a million tons a year for 800 years, puts an entirely new face on the matter. At the time of the Portsmouth treaty it was a source of surprise to some that Japan was willing to make peace without receiving an indemnity. But when one reflects that she secured control of Korea and all of southern Manchuria, and the possession of the Fushun mines it does not appear such a bad bargain after all. As far as subsequent results have gone to show, the recognition of China's sovereignty and the maintenance of the 'open door' is only 'face pidgin.'

Concessions.—The natural unwillingness of the Chinese government to give concessions to any more foreign mining companies has often provoked comment. The cry now is "China for the Chinese." But the formation of native companies to develop mineral resources does not seem to go forward with any great degree of success. After the Pekin Syndicate was bought out by the gentry of Shansi province, the Pao Chin Mining Co. was formed to develop the coal and iron. But no results are apparent as yet. Some machinery for equipping a coal mine was purchased a year ago, but it has not been set up yet. So far as I know the company has neither a mining engineer nor a metallurgist in its employ. As to the iron ores, there is at least room for a suspicion that they were a white elephant, of which the Pekin Syndicate was lucky to get rid before it was proved that there is no profit to be won in exploiting them. The whole Shansi affair seems to be a rather sorry business.

New Enterprises.—A much more promising affair is a similar company (with a name much too long to be given here, but to the effect, in Chinese, that it is empowered to develop anything it gets hold of), which has been formed by wealthy merchants of Kuangtung province. The project now in hand is to develop a lead mine. The ore that I have seen from it is good, but I do not know how much they have of it. This company has both a mining engineer and a metallurgist, both of whom have been trained in American technical schools, and the former has had a great deal of practical experience in America. The company has plenty of capital, so the outlook for it is correspondingly bright. The southern Chinese have, too, a way of getting things accomplished that is most refreshing.

A Korean grinding gold ore.

The dispute regarding the Lister-Kaye concession in Anhui province continues to drag its weary length along. It is dangerous to venture any opinion regarding it, for disputes in the Orient are generally so complicated and obscure that even the participants may not have any too clear ideas regarding them. This much of clear fact appears: the concession of these copper properties was made with the provision that they were to be developed within a specified period. The time has long since expired, the mines are not yet developed, and the Chinese are demanding them back. The only product from the mines has been material to keep the diplomats busy. Probably in the end the Chinese will pay a good round sum and get for it a few bits of machinery and the privilege of working their mines themselves. When this is concluded it will be about the last of the concessions to foreigners that have proved so unfortunate for China.

Saghalien.—The company that was formed with such energy last winter to exploit the petroleum deposits discovered on the island of Saghalien has not yet exhibited any results except to boom its stock to nearly double the par value, although it is not even known whether the deposits are going to prove profitable or not. The intention is to send the oil to Japan to be refined, as the refineries there have not much to do; they were built before the Japanese oilfields were thoroughly proved, and in the meantime the latter proved less extensive than was hoped.

MELBOURNE.

Deep Leads.—In Victoria alluvial mining once again promises to engage the attention of the investor. This is due to developments at Ararat. There the Cathcart mine is proving a splendid run of wash, bulk samples going as high as 18 oz. per square fathom. Up to the present time 12,000 fathoms have been proved down the course of the lead and the richest run of wash on the north side of the gutter has averaged consistently from 1 oz. up to 18 oz. The width of the gutter itself is about 400 ft. It must be remembered that the gold in deep leads often occurs in narrow channels, locally termed 'runs,' while the rest of the gutter may average anything from 8 to 15 dwt. The cost of working such wash as exists at the Cathcart would be about 10 dwt. per square fathom, so that all above that will pay. What the public now awaits is the treatment of the wash in bulk. Hitherto the return has been about 1 oz. per fathom, but the better quality dirt should raise that average substantially. The mine was once in the hands of Bewick, Moreing & Co., but their British supporters withdrew just before the good wash was struck, thus adding one more to the misfortunes that have befallen English ventures in Australian deep leads. These developments have led the public to furnish a considerable sum of money for the exploration of claims both above and below the Cathcart mine. It is hoped that another important mining centre will be gained to the State.

Mount Lyell.—The most interesting piece of news respecting Tasmanian mines is the striking of ore at the 1100 ft. level of the North Lyell mine, the property of the Mount Lyell Mining & Railway Co. The directors are chary about imparting information respecting the discovery, so that only a bare announcement is forthcoming. The orebody worked in the North Lyell mine is highly silicious and fluxes admirably with Mount Lyell ore. The former averages about 5½% copper and the Mount Lyell ore renders 1%. The orebody on the 1000 ft. level in the North Lyell was of considerable extent and was so strong and so rich that there was every reason to assume that it would persist in depth; but the striking of ore has been long delayed, so that the good news is a relief to shareholders. In connection with the Mount Lyell company another piece of news is that Robert Sticht, general manager, is now on a visit to the new Mount Balfour copper district. This is about 10 miles inland from Wales head on the northwest coast of Tasmania. There two brothers named Murray happened upon a big silicious copper-bearing formation carrying a high percentage of metal. They made several shipments of ore; then the Mount Lyell company equipped an exploring and prospecting party to investigate. The company has pegged 1400 acres and Mr. Sticht is to advise the directors as to possibilities. The district lies some distance north of Mt. Lyell and there is almost inaccessible country between. Several small companies have been floated to develop leases at Mount Balfour and the leading men interested in the Mount Lyell company have acquired shares. Word has reached Melbourne that Mr. Sticht is favourably impressed with the possibilities of the district, and it is hoped that this is so. A profitable district at Mount Balfour would galvanize mining in Tasmania.

New Guinea. — News is to hand from British New Guinea, or Papua, as it is more properly termed, that mining is making progress despite the climate and other vicissitudes. A good deal of alluvial work is being done on the Gira river and in the Yodda valley, and apparently plenty of gold is being won by the diggers. The men work under the mining regulations of a local act based on the Queensland law. The statute is liberal, every inducement being offered to the miner to open up the territory. The area over which gold exists is by no means limited, but it will be long before its extent is determined because of the dense forests and undergrowth, the difficulty of transit, and fever. Arthur Lyons, the resident magistrate, states that near Port Moresby good copper ore has been broken at the surface. Plenty of leases have been pegged, but as no sinking has been done nothing is known of the size of the formations or their metal contents.

The Mount Morgan mine, in Queensland, during the month of August, produced gold to the value of £23,235 from its chlorination plant, and 649 tons of copper and 7214 oz. of gold by smelting, to the value of £65,040, the total value of the month's output being given at £88,275. The quantity of ore treated was 36,786 tons. The company is awaiting the completion of the railway to connect with the Many Peaks pyrite deposit. Then the cost of bringing barren fluxes from Iron island by steamer at a considerable cost will be largely saved, for the iron sulphides at Many Peaks carry an appreciable percentage of copper. It is reported, though not officially, that the grade of the copper on the Many Peaks formation has improved at depth. But the Mount Morgan people have not whispered a word on the subject.

JOHANNESBURG.

Explosives Manufacture.—Keen competition in the South African explosives trade has had a beneficial effect upon the price of gelatine and gelignite. The custom of the Rand is now well distributed amongst the B. S. A. Co. (Transvaal), the Cape Explosives Co. (Somerset West), and Kynoch's in Natal. The last-named firm has now been manufacturing in South Africa for ten months; the Randfontein group appears to be its most loyal supporter. I visited the firm's works at Umbogwintini, in Natal, recently and found that the plant was being rapidly extended to provide for an output of 100 tons of blasting gelatine per week. The present production is 60 tons, equivalent to one fourth of the Rand's supply of blasting gelatine.

New Jagersfontein. — Most of us in South Africa are too busy to follow in detail the slow but vigorous controversy between the Premier diamond company on the one hand and De Beers and the New Jagersfontein on the other, as to the true cause of the recent diamond crisis. Each side, at distant intervals, hurls out accusations of over-production against the other. Since the Premier cannot charge the Kimberley corporation (whose policy has been followed by the allied New Jagersfontein as a matter of course) with forcing stones on the market after the crisis reached an acute stage, it can only make accusations of prior over-production. The Premier, on the other hand, is accused of recklessness right through. But, as I say, these arguments have little interest for the average member of the mining community, who considers that whatever final judgment and allocation of censure may ensue, the position will not be improved nor the ill effects of the undoubted over-production, at some time and somewhere, be dispelled. What has appealed to all has been the bold and straightforward assertion of Col. Harris at the New Jagersfontein meeting to the effect that the "diamond market has quite recovered" and that the "demand is almost as strong as it was during the three years ending June 30, 1907." He has also declared that the scale of operations at De

Native compound, Kimberley.

Beers and Jagersfontein would probably be increased by the end of the year. A few statements like this are worth a score of contentious victories.

Free State Oil.—The report of J. H. Ronaldson appearing in the prospectus of the Free State Oil Exploitation Co. is a thoroughly sound common-sense production and compares favourably with many of the high-flown compilations dealing with oil prospects in the O. R. C. The venture is being formed with a capital of £30,000 (£12,500 working capital) to prospect in the Ladybrand-Clocolan district. The possibilities for the occurrence of oil in payable quantity in the region are stated by Mr. Ronaldson to be indicated by (1) the undoubted presence of oil in two or three igneous dykes around Modderpoort, one of the central farms, (2) indications of oil on surface water, (3) the presence of a small quantity of oil in the borehole at depths of 900 ft.

and 1600 ft., and (4) the reported indications of oil at Harrismith, 140 miles northeast. The area in question is covered by the flat sandstones of the Stormberg series of the Karroo System, intersected by diabase dykes.

Leasing Bewaarplaatsen. — Whatever may be the rights and the wrongs of the Government's unreserved disposal of mining privileges under 'bewaarplaatsen' (depositing sites), machine-stands, and water-rights, without considering the claims of the surface holder, the policy has undoubtedly been carried to an extreme in the offering of the 15·8 claims south of the Robinson for public tender. Allowing for dykes, etc., there may be estimated to be 14 lode-bearing claims 'under the hammer,' for the exploitation of which an independent company would have to sink a new shaft of about 1300 ft. and erect a new mill. That this work could be done for a big profit cannot be doubted, for the area is in the richest portion of the Rand, where the widths of Main Reef Leader and South Reef are great and gold contents high. But the natural treatment of such a small block is through the shafts of adjacent mines, whose existing mills can treat the ore for a far greater profit than is possible with an independent concern. There is no reason to believe that these companies would fail to deal with the Government on fair terms, enabling it to gain a bigger return than if money has to be squandered on a needless shaft and reduction works.

Abercorn.—Writing at a distance, it is difficult to express an opinion as to the soundness of the rush for claims in the Abercorn district, in Rhodesia. That the Consolidated Gold Fields is opening up an exceptionally rich body of ore is undoubted. An interesting account of the district has appeared in the *Rhodesian Mining Review*, written by F. P. Mennell, the best authority on Charterland geology. He appears to be satisfied that the Abercorn grits, sandstone, and quartzites, with occasional pebble bands, though differing lithologically from the rocks of the Lomagundi district, are nevertheless geologically equivalent to the formation in which the Eldorado mine occurs.

Northeast Rand.—When speculation was at its height a few months ago several parties acquired interests eastward of the eastern rim of the Rand basin. The sub-outcrop of the Main Reef series has been proved by boring to lie on Holfontein, with a normal westerly dip. The ground under consideration, however, lies farther to the east, and can only be of value if another and independent basin of Rand formation is found thereon, below the more recent systems. There is little to support this hypothesis, and all prospecting on the strength of such a theory is a pure gamble. There seems to have been great delay in starting the bore-hole, owing probably to the less favourable stock-market conditions. A hole is to be started shortly on Rietvlei, about 5 miles east of Holfontein, under the auspices of three syndicates. The decision to bore for the Main Reef in this far easterly district calls to mind the circumstance that three bore-holes were sunk (also when the market beamed upon the projectors of bold schemes) in the West Rand, to seek for the extension of the Main Reef beyond the South Randfontein Deep. Although the sponsors of these bore-holes expressed themselves in terms of bold confidence as to the "certainty" of striking the Main Reef, nothing has yet been heard as to a strike of importance.

East Rand.—Lewis & Marks, through their company the East Rand Mining Estates, have for so many years been identified with the far eastern basin between Modderfontein and Nigel, and have done so much drill-prospecting under the scientific direction of F. H. Hatch, that the delay in the commencement of actual mining has been a cause for regret. The postponement of operations seems to have damped public interest in the concerns of the company, for the extreme importance of the shaft-sinking now commenced on Grootvlei by the Grootvlei Proprietary (one of the Estates' subsidiaries) has been poorly appreciated. Last year the Brakpan Mines cut the reef in their No. 2 shaft with satisfactory results, which have thrown a different aspect upon the prospects of the area. Early this year the Springs Mines commenced shaft-sinking further south and now the Grootvlei company has started still nearer the southern rim of the syncline at Nigel. Of bore-holes we have enough in this region. A few more shafts and a few more thousand feet of development are needed to represent what a bore-hole core does not, a true 'sample' of the district; and then we shall be able to determine with confidence whether this eastern area is to be the mainstay of the industry a generation hence, as many of the optimists believe.

Rapid Driving.—As previously recorded, the New Modderfontein set up a record in July, when two drifts on single shift were advanced 349 ft. during the month. In September its neighbour, the Modder B, established a new record, for one of the drifts, on double shift, was advanced 334 ft. in 62 shifts. Two heavy Ingersoll-Sergeants were employed and the face was 6 by 7 ft. An average of 12·5 holes was drilled per round. In some respects the New Modderfontein's accomplishment is the more creditable, although the advantages of working single shift were gained. The ground was deeper and probably harder, and the actual footage made per round was higher.

MEXICO.

Political Outlook.—In all countries politics affect finance, and finance affects industry, and in a country like Mexico where the great mass of the people are still in too elementary a state to appreciate democratic self-governing institutions, and have to be handled by a wise paternalism, these relations are emphasized. A fearless discussion of the subject from time to time may assist the foreign investor to obtain a clearer grasp of the real state of affairs. It is believed by many foreigners that if only the foreign Press generally would take up the question of reform in Mexico, in a spirit of friendly and just criticism, in place of mere laudatory support alternating with sensational attack, many much needed reforms could be brought about, and foreign investment and immigration would thereby be stimulated.

The Reyes agitation has been so bruited abroad by the daily Press that to overlook it would be absurd, especially as it delayed the investment of capital by persons unacquainted with the genuine stability of the Mexican government. The successive phases of the situation were confusing from an Anglo-Saxon point of view, considering that General Reyes first appeared as a peaceable political candidate for nomination at the vice-presidential elections of next year; and Reyista clubs, papers, and meetings were flourishing all over the country; then without any apparent overt act on his part General Reyes fell under a ban, some inflammatory speeches were made, and articles appeared criticizing the Government. This resulted in rioting and stone-throwing, followed by the prompt suppression of both the rioters and of the newspapers, by the imprisonment and punishment of those directly concerned. General Reyes promptly retired to his country seat, an event followed by the dispatch of a body of troops to Nuevo Leon, the State of which Reyes was then Governor. A military man was virtually placed in charge, and Reyes was quietly but surely stripped of all his personal and political prestige, which resulted in his declining to stand as candidate for vice-president. He retired from the post of Governor, and even realized on his private estates and investments, and he is now preparing for a genuine tour abroad.

This might be interpreted as a gross outrage on political liberty, and the proof that the stability of the Mexican Government depended only on a military autocracy, and has so been interpreted by several American newspapers. But before condemning in a hurry we must remember the conditions, the traditions, and the immediate history of the country. Well informed natives state that Reyes was making political capital out of the anti-foreign

Rurales on parade in Mexico City.

feeling and was also pandering to the rowdy element of the country, and as it was seen that he was not suitable as a governing factor he was suppressed. But it is not our purpose to discuss here the question of Mexican politics in general, but to give such of our readers as are investors in Mexican mines and industrials, a personal observer's intelligent interpretation, as far as it affects the security of property.

Assurance of Stability.—The best interpretation was given by an intelligent old Mexican who had worked with the present governing body from its beginning; he said much as follows: "The majority of the Mexican people are still ignorant Indians, susceptible of being driven by a military leader, but incapable of self-government. The present government is really a representative clique, composed of the more intelligent and wealthy men of the nation, with Diaz at the head, and a well organized and contented army at the back, and with the form and ritual of a republican government. Every effort is being made to educate the people up to a self-governing status, but meanwhile the powerful and intelligent interests hold together, and when Diaz either retires or dies the system will go on just the same, only the name of the President will change; and as a step in the reduction of the military influence and the increase of civilian prestige, it is thought that the desire of those in control is that the next president shall not be a military man, and hence Ramon Corral is actually vice-president and is also the government nominee for the next term of that office. The mass of the people would never attempt to change the order of government without leaders; the bulk of the intelligent Mexicans and the representatives of capital realize thoroughly that there is a jingo element in the United States that would try to raise an issue if any trouble occurred, and they will always restrain personal prejudices in the interests of the integrity of their country. Go ahead; you may tell all your friends to invest in perfect security, the Government is not dependent on one man, but upon a powerful group, with the bulk of the intelligent and influential men of Mexico behind them."

I believe this to be an accurate statement. Capital may be invested in Mexico today with as much security as in the United States or in Canada, and with perhaps better security, from a capitalist's point of view, as regards the question of adverse taxation. The meeting of the two Presidents, Taft and Diaz, on the frontier seems to be made merely as a matter of friendly courtesy, and not with the object of any important political changes in the relationship of the two countries.

Sinaloa is coming to the front. One of the important companies operating in the Concordia district is the Panuco, a local concern with headquarters at Mazatlan. They have been operating since 1877, and in the past 25 years they have paid 10,000,000 pesos to the stockholders. An average of 50,000 pesos per month is being distributed in dividends. The Butters-Copala Syndicate is operating in the same district. Their 40-stamp mill, which was started several months ago, has been averaging 250 tons per day, and it is the intention to increase the output to 400 tons per day, which is the full capacity. In the Ayutla district of Jalisco the Los Ailes Mining Co. has struck a rich body of copper ore on the Aguacate vein, and arrangements are being made to ship the ore to a smelter.

NEW YORK.

Copper.—The most important happening of the month is the agreement made between the controlling interests in Nevada Consolidated and Cumberland-Ely for the merger of these two companies. Nevada Con. is controlled by the Guggenheims, who also have the nominal control of the American Smelting & Refining Co. The company has a capital of $7,500,000, the par value of the shares being $5. The shares of the Nevada Con. Company have been holding around $25 in the New York curb market. Cumberland-Ely has a capital of $6,500,000, the par value being $5 per share. In these shares there has been alternate strength and weakness for several months. At times they have sold as high as $9 and again they have declined to nearly $5. The agreement that has been made for the merger contemplates the creation of additional share capital for Nevada Con. and the issuing of those shares for Cumberland-Ely shares on the basis of one share of Nevada Con. for each 3¼ shares of Cumberland - Ely. Nevada Con. thus becomes sole owner of the enormous Steptoe reduction plant and of the Nevada Northern Railway.

Talk of a gigantic copper combination to be organized by the Amalgamated Copper Co. through Morgan & Company will not down. The report is that the intended consolidation includes the Amalgamated and the Cole-Ryan interests, the Phelps Dodge interest, and those of the Guggenheims. Such a combination would bring in practically every important copper mine in the United States outside of the Lake coppers and the group controlled by the Lewisohns. It would include Anaconda and North Butte, Utah Copper and Rey Con., Greene Cananea, Copper Queen, Calumet & Arizona, Superior & Pittsburg, Detroit, Giroux, Nevada Con., Cumberland-Ely and the undeveloped interests of the Guggenheims in Alaska. Remaining outside of the combination would be the Granby and other British Columbia mines, Miami, Old Dominion, Tennessee, Arizona Copper, Boston Con., and a number of lesser importance. Some of the people connected with the International Smelting & Refining Co. have been laying plans for this consolidation and if it is finally effected the International group will doubtless be most prominent in the combination. At the head of this group are Thomas F. Cole and John D. Ryan.

El Tigre.—James W. Malcolmson has telegraphed to New York that two feet of rich ore has been found on the seventh level of the El Tigre mine, in Sonora, Mexico. The ore averages 120 oz. silver and about $4 in gold. The El Tigre was, until late in August, under option to Thomas H. Leggett and Fred Hellmann, acting for a syndicate of English and American capitalists, at $6,250,000. Prior to that time the mine was under option to the Exploration Company at a somewhat higher figure. Both options were allowed to lapse although it is understood that there is developed in the mine a very large tonnage of ore worth something over $20 per ton gross, the total gross value of the developed ore being in the neighbourhood of $12,000,000.

pany will disburse 37½c. per share quarterly instead of 50c. per share as had been expected. John McMartin, Henry Timmins, and Duncan McMartin have resigned as directors of La Rose Consolidated. Their places have been taken by friends of the president, D. Lorne Gibbon of Montreal. La Rose now seems to be controlled by capitalists who are also largely interested in the Nipissing.

Options.—It is reported that the Exploration Company has taken an option on the Blanca Mine at Pachuca, Mexico. [This is denied officially.] Engineers arriving in New York from the City of Mexico express the belief that the Camp Bird company, which

Butte, Montana.

The curb market is the centre of a genuine boom in the shares of copper mining companies operating at Ely, Nevada. Chief among these companies are Nevada Consolidated and Giroux. The leaders in point of activity, however, are several porphyry coppers whose orebodies have yet to be developed. Chief among these are Ely Central and Ely Consolidated.

Dividends.—Butte Coalition has declared a dividend of 25c. per share, payable December 1. The dividend is announced as a quarterly disbursement. The par value of the shares is $15. The initial dividend on Nevada Consolidated was disappointing. The Com-

has practically concluded the purchase of the Santa Gertrudis, will pay a high price for the mine in view of its developed ore reserves. [In London it is understood that R. J. Frecheville's report will show that the purchase price is amply protected.]

Homestake.—The annual report of the Homestake Mining Co. shows gross earnings for the year of $5,725,046. Dividends amount to $1,365,000. The amount carried forward to surplus is $233,471, greater than it was for the fiscal year ended in 1908. The Homestake will effect a large saving by the installation of a central electric power-plant to take the place of the many steam-plants.

CAMBORNE.

Trenwith Mine, one of the properties owned by the St. Ives Consolidated, has been unwatered 80 ft. below the adit. The suction gas plant, which was so successful at Tywarnhaile, is equally effective here. The same electric pump also that drained Tywarnhaile mine to the 40-fathom level continues to do good work. At St. Ives Consols a new suction gas plant is being erected of practically 1000 h.p. for the further working of this mine, which was at one time rich in tin and high-grade copper ores. Pitch-blende has been found in these two mines and the present working is primarily for this mineral.

Bobs.—The past week has witnessed the arrival of two of the largest 'bobs' or beams ever brought into the county. There was a time when 'bobs' were sent away by the score to other mining districts, but now, instead of 'bobs,' almost every other kind of machinery is exported save filter presses, which were tried in Cornwall more than fifty years ago, but not on the mines. One of these 'bobs' weighing 38 tons was brought to Redruth from Glasgow for use at the Basset mines. The other 'bob' weighing 34 tons, was brought from South Wales to Great Wheal Busy. To deliver the latter 'bob' to the mine two large traction engines were necessary.

Tresavean Mine.—This mine at Gwennap has been unwatered to 75 fathoms under the adit, and the old pitwork consisting of 16 and 18 in. pumps, which was left in the shaft, has been sent to the surface; the pumps are in such good condition after 25 years immersion that they will be again used in another mine. Harvey's shaft, which is vertical, is said to be in good condition to the 300-fm. level. This mine was at one time the premier copper mine of Cornwall and paid dividends to the extent of £50,000 in one year. The plans of the mine show extensive workings; consequently, there is a large volume of water to be pumped. The electric pump has done well, 'forking' about six feet per day.

Carn Brea & Tincroft sand heaps are being treated on the old tin-floors of Wheal Agar, at Redruth. The tailing is brought about two miles by traction and is concentrated by means of 'strips,' the 'heads' of which no doubt will be later pulverized, provided the test should prove satisfactory. A London syndicate is making this test.

Carnon Stream.—The syndicate formed to work the sand in this stream recently secured an injunction to restrain certain parties from removing the sand for building purposes. There was much conflicting evidence, the defendants claiming the sand to be practically valueless as a source of tin, whereas the manager, Charles Harvey, estimated a profit of one shilling per ton treated. The Judge placed the profit per ton of sand at six pence, and awarded damages accordingly. The bulk of the evidence, however, went to show that the contents were too low to warrant metallurgical treatment.

South Crofty.—The discovery made last month at the 160-fm. level continues to maintain its value, and is apparently one of the best finds made in Cornwall for many years. The County is in need of a few good strikes of mineral such as this.

Grenville. — This is a good mine but severely handicapped. A vertical shaft 5 by 17 ft. should be sunk to intersect the vein at a depth of 400 fathoms. Of course, it costs money to sink deep shafts, but mining cannot be conducted without them, and they should be well equipped with pumping and hoisting appliances. No doubt £50,000 expended here for that purpose would be money well spent. The land-owner, who has done much to help the mine, would probably be only too pleased to contribute £10,000 toward the cost.

West Kitty, St. Agnes.—The sales of tin from this mine have been materially reduced of late, due to a reduction in the tonnage milled, in the first place owing to the suspension of the air-cushion stamps through the failure of the foundations, and later to the suspension of the principal stopes in the Friendly section of the sett, the stuff from which Captain Prisk has decided it will not pay to break and dress. The manager is now directing all his energies to unwatering the Thomas and Reynolds sections, but the engine and the pitwork at the latter are in bad condition, and the progress is slow.

East Pool & Agar United.—At the recent meeting it was found necessary to make an assessment of 14s. per share to cover the quarter's loss, and much was said on that occasion about the neglect of the developments in the bottom of the mine. For the tonnage milled, less development work is done than at any other prominent mine in the county, and it behoves the management here to remedy this unsatisfactory state of affairs if East Pool is to maintain its position.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Labour in Mines.

The Editor:

Sir—Much has been written from time to time by mining engineers, and others engaged in mining, regarding the labour problem in various parts of the world. A careful perusal of the articles published indicates that the most important point has been missed. What I have to say will be based upon the employment of white labour only. After many years of experience in handling large numbers of men in the United States and Australia, in the course of which I have reduced costs without disturbing the rate of pay except by increases where it was considered necessary, I deem it proper to record facts that may be useful to others engaged in the management of mines.

In directing mining enterprise, one of the first things to be considered is the class of labour available. Then come the two other factors; the rate of pay and the number of workmen available. These three points must be kept in mind when estimating the profit to be expected from the treatment of ore. Most writers, in dealing with the relation of labour to industry, pay particular attention to the cost of the individual rather than to his efficiency when employed under economical conditions. It is just as necessary to ascertain the standard of efficiency of labour as it is to study the percentage of extraction of the valuable contents of the ore. One often hears of labour troubles in various parts of the world, and the whole of the blame is laid upon the employee, but this is unjust and illogical. Having served my time both as employee and employer, it is with some knowledge of the actual inner workings of these matters that I venture to speak thus. Nine times out of ten the employer is represented by shift-bosses who have risen from the ranks, who may lack the sense of responsibility, and are not altogether capable of handling even the men with whom they have been formerly associated as mates. As a rule, there is but little sympathy between the employer and the employee, and when dissatisfaction occurs, such as is occasionally inevitable to the employment of labour, instead of their being that sympathetic feeling between the boss and the workman, there is only antagonism. This can be overcome by a little diplomacy on the one part and a little reasonableness on the other.

Where workmen are dominated by labour-unions the employee appeals to the union for protection or for an adjustment of the conditions under which he is working. The officials of the union call upon the employer and lay before him their objections, sometimes in a haughty manner, which naturally does not tend to smooth matters, but creates a discord that reacts back to the working-man through the labour-union official, causing grievances that might easily be overcome if diplomacy had been exercised in the first place by the employer himself dealing direct with the labouring-man, or, if necessary, dealing with the representative of the labour-union in such a way as to create good feeling.

It is hardly surprising that the working-man does not understand the position and policy of the employer as well as the employer appreciates the reverse position. Therefore, if there is no sympathetic feeling between them there will shortly develop a breach that will be very hard to overcome. My advice would be first of all to maintain a high standard of pay to the individual; disregarding for the moment the grade of the ore or material to be treated. Select the best overseers that can possibly be engaged, furnish the workmen with the best tools that can be purchased, making the working conditions as nearly perfect as is practicable, give the employees to understand that they must do a fair day's work and that you are prepared to pay them a fair day's pay. If they do not accept these conditions and return good service for good pay, then it is time to discharge the individual and replace him by one who is willing to abide by these conditions. It is not argued that this method will act successfully with every individual, nor will it bring about satisfactory results immediately, even though the conditions on a particular mine may be such as to warrant a complete reversal of the methods previously employed. By observing the points referred to above, within a few months it will be found that a greater tonnage per man will be handled, in fact, far out of proportion to the additional wages that may have been granted, even though it take the appearance of an extravagant increase in pay. Usually by the payment of fair and reasonable wages the working-man will be satisfied, he will live a happier life and he will be able to purchase just a few of the comforts that would otherwise be out of his reach. When conditions such as these have been brought about, the employees through their unions may ask for a re-adjustment of wages, especially before the expiration of the agreement under which they are working. This is only fair, and must be expected when it is considered that the employers themselves, long before the expiration of the agreement with the employees, call meetings of other employers to discuss the rates of pay to go into effect at the expiration of the agreement referred to. At the same time the labour-unions will call their various representatives together to discuss the rates of pay they are prepared to accept. After many meetings have been held by employers and employees separately, delegates are selected on each side to confer and bring about, if possible, a settlement. Having had several years experience in these matters, I can truthfully say that a great amount of time is wasted on both sides for the simple reason that the employers give the labour representatives to understand that a reduction will be demanded below the rate paid under the original agreement, and the employees, through their labour-union representatives, ask for an increase above the rate of pay fixed by the agreement under which they are working. After haggling for several days, sometimes weeks, if wise counsel prevails, the old rate is usually accepted. Much loss of time could be saved, in the first place, by telling the employees what would be deemed a standard rate of pay, and not budge from the promise under any consideration. It is natural for the employee to ask for an increase of pay if the employer asks for a decrease. It must be remembered that the employee has nothing but his labour for sale, and it is the highest bidder who will obtain his services. In my opinion altogether too much time is consumed in discussing the rate of pay of the individual instead of discussing the efficiency that may accrue when the individual is under proper supervision. When a high rate of pay prevails with indifferent results it is apparent that a radical change should be made in the management and a general re-organization of the staff effected at an early date rather than disturb the scale of wages.

In attempting to lessen the working costs most people imagine that the only way is to reduce the rates of wages and to increase the tonnage. It will not be improper to quote a few figures showing results that have actually been brought about by the writer, at the Sons of Gwalia, a mine where an increase of pay took place in many departments, with results economically satisfactory. Prior to taking over the active management of the property there was an average of 814 men employed, the pay-roll ranging from £12,475 to £13,500 per month, the tonnage treated averaging about 7700 tons per month at a cost of 35s. 9d. per ton. An average of 300 ft. of development work per month was being done at an average total cost of £3000. These averages were for the first three months of the year. Conditions were gradually improved until the following was the result for the last month of the same year, although it will be noted that there was no increase in the tonnage treated: 7708 tons of ore treated at a cost of 25s. 7d. per ton, the pay-roll amounting to £9332. Development, 522 ft. at a cost of £3397. Twelve months later 7800 tons of ore were treated at a cost of 20s. per ton, 514 ft. of development work at a cost of £1974, and a pay-roll totalling £7091. Therefore it will be seen that the development footage was nearly doubled at £1000 less cost than at the beginning of the period under review, and a saving in the pay-roll of £5000 to £6000, a saving of 15s. per ton on the working costs; and it might also be stated there were less than 400 men employed.

It cannot be argued that these reductions were brought about by an increased tonnage, nor was the decrease in the number of men brought about by operating the open-cut system or anything of the kind. The usual amount of development work was carried forward in the deeper levels of the mine, which at that time was at a total depth of 1000 ft. It may be of interest to quote some figures from the same property, several years later. The same plant is treating at the present time 13,000 tons per month at a total cost of 15s. 3d. per ton, including the treatment of concentrate and slime, which was not included in the early days. The development is now 893 ft. for £3705. The grand total number of men employed is now 428; the pay-roll, including contractors, £8557. These results have been brought about by close supervision and fair treatment of the employees. There has been no decrease in the rate of pay. The contract system has been used wherever possible, and if the workmen through any fault of his own fails to earn the rate of pay that is fixed by the Arbitration Court for such work as he performs, he is promptly dismissed; but, on the other hand, if the contract price is a fair one in the opinion of the management, and, through no fault of the contractor, he fails to earn the ruling rate of pay, at the end of the period the contractor is given a contract whereby he can earn an increased rate of pay to make up for any loss previously incurred. On the other hand, if a contractor has good luck and makes a few shillings per day over and above the ruling rate for his class of work, the money is his and no reduction is ever made in granting a future contract to him. By this means there has been brought about a much better feeling on the part of the employees, so that the men are satisfied to work under the conditions now prevailing.

W. J. LORING.

London, October 26.

Investments and Speculations.

The Editor:

Sir—Mr. Worpledon can be no other than our long lost Sherlock Holmes. However, he is mistaken; I am not the author of 'Investments and Speculations.' Certainly Sherlock has lost his cunning since he disappeared under that avalanche of copper shares at St. Moritz, if he thinks that is my method of working the Stock Exchange. That way is crudely honest and provides no profits from 'wild cats.' Killing cats brings no revenue; skinning them does.

Class	I	Board of Directors	Capable, Honest, Hardworking.
,,	II	do.	Capable, Hardworking.
,,	III	do.	Honest, Hardworking.
,,	IV	do.	Hardworking, but they work others.
,,	V	do.	Dummies and Duffers.
,,	VI	do.	These control the Dummies.

Now, Sir, as my old friend Sherlock has re-appeared (hardly in form yet, as I shall show later) and as his re-appearance synchronizes with my attainment of a complete competence by way of operations in the Rhodesian and West African markets, I have determined to retire and to give to your readers the real key to successful speculation on the Stock Exchange. I send you herewith my confidential table* of all the mines quoted on 'Change, classified according to an infallible principle. The following notes will explain it:

Companies under Class I usually have a mining engineer on the Board; shareholders and the public get a frequent and an equal show as regards information affecting the value of the property. These are no good to me.

Class II. Shares difficult to manipulate; the directors hog it all themselves; no show for an outsider.

Class III. The directors tell the truth when they get it; one can do very well in the shares of this class by getting it first.

Class IV. Great opportunities are offered to the wide-awake speculator. The directors don't know what truth is; they don't know the real value of their mine; and can be relied upon to interpret everything as a bull point, from collapse of the shaft to shutting down the mill. (*Vide* Rhodesia and West Africa practice.) The wary punter can catch this lot going and coming, bearing and bulling.

Class V. This list, you will see, is full of names. They are of two sorts: those still under 'control,' as listed in Class VI, and those adrift. The latter are dangerous to both honest men and thieves. They blunder along without rhyme or reason, telling intentional and unintentional lies in a bewildering way, besides destroying the value of good mines by bad management. That portion of Class V still in control forms a prolific field. One only needs to 'stand in' with the 'control' or to know and watch him.

Some years ago, when my old friend Sherlock disappeared, I was much discouraged by the results ensuing from the application of my method, largely due to his efforts; now 'Speculator and Investor' bobs up and puts further difficulties in my way. In the meantime, I have done well—very well. But I have one parting word for my old friend Sherlock. He has been on ice a long time; it is evident enough when he proposes to move Nevada Consolidated and Utah Copper into the first column. Since he went away, Utah Copper has proved to have a milling value of only 24 lb. copper per ton, instead of 28, as the Board believed and hoped. Nevada Consolidated has been delivered by the 'control' of a large part of one of its best assets—the railway—in return for a mess of potash, in the shape of Cumberland Ely shares, so that now, when due regard is paid

* The law of libel makes it inadvisable for us to publish Professor Moriarty's table. At the same time we welcome the views of so renowned an authority, even though they be expressed in somewhat cryptic fashion.—EDITOR.

to the inevitable increase of costs in the near future, it is only a 5% investment and money back with copper at 12·5 cents. I fear, however, my old friend can no longer smell the value of a mine from the Chairman's speech.

'Investor and Speculator' will be well advised to accept Worpledon's hint re Mexico of El Oro, but move it back three columns instead of one, not for Worpledon's reasons, but because the jobber who has had large calls from the 'control' has about finished his job.

JAMES MORIARTY.

West African Mines.

The Editor:

Sir—If I am not too late I should like to make a few comments upon the article by Mr. Curle appearing in your issue for September.

The application of a biblical story to picture the condition of the mining industry in West Africa may be very striking, but in my opinion Mr. Curle's illustration does not fit the subject. As all mining engineers must be prophets, I see no reason why Mr. Curle should not liken himself unto the prophet Elisha, but he is rather hard on Lord Harris and Mr. Edmund Davis when he casts them for the unfortunate part. The chief exception to the application of the story is the statement that at the time of Mr. Curle's visit to West Africa the industry was suffering from a terrible disease. The industry undoubtedly was much run down and anæmic, and required strong doses of tonic, in the shape of additional working capital, and possibly it needed the stimulation of the fresh ideas of newly imported engineers.

Apart from anæmia, or impecuniousness, it was physically and constitutionally sound enough, with red gold in its veins; requiring only a stimulant for its recovery and circulation; as was testified by so many of the consultants who were called in at the time to advise. But to say that it was suffering from disease, shows how dangerous it is to apply biblical stories to mining industries.

The evolution of the industry, has been by the stages common to mining in a difficult country. When the boom had subsided into a slump it was followed for many years by a period of depression, when the few prospects surviving had to struggle to be mines, finding money for equipment as best they could, at the risk of exhausting their scanty ore reserves. The sneers of the market place and the cold shoulder from their former friends had to be endured. Those mines that did not succumb in the hard struggle acquired strength; and the engineers that knew them and worked among them, did their best with the scanty means available, to bring them into their own.

The camps were improved. The bamboo shacks, from which the occupants were often ejected by the driver ants, were replaced by excellent wooden bungalows. The boilers gradually ate up the trees surrounding the camp and thereby admitted the light. The native villages were superintended by the Medical Officer and improved, although much remains to be done. The railroad slowly crept up country. The natives were taught to mine ore, drive engines and machine-tools, as Mr. Curle says, as well as any white man. Owing to the limited working capital and consequently the employment of as few whites as possible, the most had to be made out of the native, and it speaks well for the whites that the training of the natives has been so highly praised.

Various stores gradually opened for business, and now flourish upon the spending power of the native. As the cash resources of each individual mine permitted, so the mines developed slowly, and slower still at depth. Plants were erected, to be expanded often from the original unit, resulting occasionally in a somewhat grotesque segregation on badly selected sites. But the development was carried far enough, and with sufficient success, to attract the attention of the financial houses dominant in other regions.

New capital is now being poured in, and the industry that was carried so far by sheer determination under adverse circumstances, now, by the proper application of this capital, including the fight against the mosquito, can be brought to a flourishing condition, which should well repay those who stuck to the field during the troublous period of uncertain development.

ERNST LICHTENBERG.

London, October 25.

The Editor:

Sir—I have been much interested in the article by "a professional speculator" that appeared in the first number of your magazine. I think, however, that his classification of West African shares might be improved upon. He places these under five heads—'excellent,' 'fair,' 'moderate,' 'indifferent,' and 'remote'—and says that the 'indifferent' shares have some value, but they exhibit a great gap between price and merit, that "they are not likely to come into Class I except by the most astonishing chance of fortune, and as an investment rank with roulette," and forthwith apportions United Exploration to the 'indifferent' class.

In July this company was amalgamated with the Gold Coast Investment Co.; its issued capital is £270,000 in 1,080,000 shares and by means of a portion of this issue plus the cash resources of the old companies, the sum of £37,000 became available as working capital. The strength of the company, however, lies in its share assets, which include holdings in the Abbontiakoon, Appantoo, Effuenta, Fanti Consols, Fanti Mines, New Gold Coast Agency, Prestea Block A, Prestea, Wassau, Wassau West Amalgamated, West African Gold Trust, West African Union Mines, West African Oil & Fuel, as well as sundry other interests. The market value of these shares, plus the cash, was then officially stated to entitle the share to the value of 7s. 4d., whereas the price was about 6s., and is now only 5s. In view of this fact and of the undoubted soundness of practically all of the company's West African Investments, its shares surely deserved to be classified as 'fair.'

There is somewhat of a gulf between 'fair' and 'excellent'; the classification 'good' might well have separated the two, and in that case I should style both Abbontiakoon and Taquah as 'good' rather than 'fair,' and Abosso, Fanti Consols, and Gold Coast Amalgamated as 'excellent' rather than 'good,' though I note your correspondents calls these latter only 'fair.' As regards Abosso, when Arthur Wilkinson made his report on the mine he stated that it was one of the finest banket mines he had ever seen. In the meantime developments have been better than ever; at the Oceana meeting it was stated that the ore reserves were far in excess of the requirements of the present mill and that it was intended to more than double its capacity. Mr. Wilkinson, adopting a conservative view, estimated the mine's ore reserves at 265,000 tons, at 11·3 dwt. per ton. Since then developments have been both energetic and satisfactory. The company has an issued capital of £350,000. Therefore at 50s. per share its total market capitalization would be £875,000. The reef-bearing claims number 369, but if we take no account of one half of them, and only apportion value to 180, which would cover the workings of the present mine, the result is that in a 50s. price of the share these 180 claims would be valued at £4800 each; if the whole 369 claims came into our calculation the price per claim would be less than £2400.

I should require too much space to sum up the positions of Fanti Consols and Gold Coast Amalgamated, but I think that anyone who cares to delve carefully into either would classify them as 'excellent.' The position as regards Fanti Consols was clearly expressed in an article on October 25 in the *Financial News*, and some idea as to the position of the Gold Coast Amalgamated Mines may be gathered from the *Financial Times* 'Handbook on West African Mines.'

I have no reason to criticize your correspondent's other classifications except that Wassau West Amalgamated might at least come from the 'indifferent' into the 'moderate' category, seeing that the valuation per claim here works out a mere bagatelle. Moreover, why class Prestea as 'fair' and Appantoo as only 'moderate'? In making these remarks I quite understand that the classification of the shares was made in relation to their value as speculative investments at the then existing market quotations. Thus, while a given mine in the list would be rightly deemed excellent as a mine it might be too highly capitalized to be termed excellent as a speculative investment. A classification of this kind requires deep thought and probably no two opinions would coincide. With regard, however, to the Tarkwa banket formation any company that can rely on a recovery of 30s. per ton when crushing with at least 100 modern stamps deserves to have a fair value apportioned to its unexplored claims.

J. R. F. TURNER.

Elandslaagte, Oxford,
October 29.

Zinc problem in northern Mexico.—The result of the new United States tariff against the importation of zinc ores, seems likely to be solved by the establishment of a zinc smelter at Sabinas, State of Coahuila, 72 miles south of Eagle Pass. It is expected that by January active work will be begun on the erection of a plant; the scheme is being backed by J. T. Willet, with the support of Kansas City capitalists. Sabinas is a good point for the establishment of the enterprise; there are coal mines in the neighbourhood, and a water supply can be obtained. It is favourably situated with regard to transportation, as the spelter can be shipped to Europe, in bond, on through bills of lading, via the ports of New Orleans and Galveston.

METAL MARKETS

COPPER.

The course of the copper market during the past month has been unsatisfactory and disappointing. Weakness supervened on the publication, at the beginning of the month, of the European statistics, which showed a further large increase in the visible supplies; and heavy liquidation by disappointed speculators took place on the London market, which broke sharply from £59 cash to £57 10s. The lower level proved rather attractive and a fair consumers' business took place, while there was also evidence of some bear-covering, which caused a slight reaction; but the mid-monthly figures and the advance of the Bank rate proved too much, and the market relapsed into a dull state with prices closing practically at the lowest.

Rumour has been busy with talk of the proposed amalgamation with some of the leading American producing interests, or at any rate, of some arrangement to restrict the over-production that is going on at present, and there seems no doubt that negotiations have been entered into. Although the difficulties attendant on any such arrangement appear almost insuperable, the ingenuity and resource of American financiers may yet prove successful.

Meanwhile the future of the copper market on this side is not particularly bright, and were it not for the tremendous attraction that the metal seems to have for the speculative public, it is difficult to see how prices could maintain even their present level, in face of the rapid increase of stocks, which, with the consignments afloat, amount to practically 100,000 tons. With the present dear condition of money, and the possibilities of a further increase in the Bank rate, the financing of such a tonnage is no light task. Consumption in the United States is on a large scale, as a necessary sequel to the great expansion in the iron and steel trades, although the demand from the electrical industry is still rather disappointing. Europe has scarcely felt the influence of American prosperity yet, and buying has been of rather a hand-to-mouth description.

The American Copper Producers' Association publish the following figures for the month of September: Production, 52,689 tons; Deliveries, 45,617 tons; Stocks on October 1, 67,622 tons; Increase for September, 7072 tons.

Average prices of cash copper:

October 1909.	September 1909.	October 1908.
£57 13s. 1d.	£59 3s. 3d.	£60 5s. 3d.

TIN.

This market has ruled comparatively steady throughout the month, and the efforts of the bear party, assisted as they were by dear money, have met with little success, the month closing with prices practically at the same level as the opening. The condition of the tin-plate industry, both in this country and in America, is extremely satisfactory, and the outlook generally is very favourable.

Average price of cash tin:

October 1909.	September 1909.	October 1908.
£138 13s. 2d.	£137 14s. 6d.	£133 8s. 8d.

LEAD.

Preceded by a general improvement in the shares of the more important lead-producing concerns, the attention of both consumers and speculators was drawn to the metal. A large business took place, although toward the close of the month the weakness that was developed in other markets exercised some influence on the course of prices, and induced consumers to restrict their purchases, which so far have been mostly for early delivery. Nevertheless the position of the metal is a strong one, and it is quite possible that supplies for Europe may become rather scarce, owing to the increased consumption in America and the reduced output from Spain and other countries.

Average prices of soft foreign lead:

October 1909.	September 1909.	October 1908.
£13 4s. 4d.	£12 15s. 3d.	£13 7s. 2d.

SPELTER.

Galvanized iron continues in good demand and production at present is on a record scale. This has naturally caused a good enquiry for spelter, and producers are well sold. The outlook for the metal is satisfactory, and it has only been due to the conservative policy of the spelter syndicate that the price has not been advanced to a much higher level than it is at present. We refer to the Broken Hill production elsewhere.

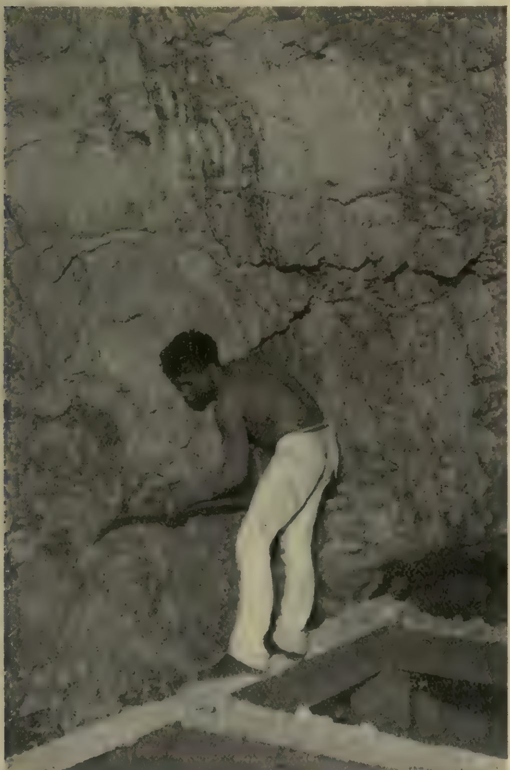
Average prices of good ordinary spelter:

October 1909.	September 1909.	October 1908.
£23 3s. 4d.	£22 17s. 2d.	£19 15s. 1d.

LOOKING FOR MINES IN MEXICO

By W. A. PRICHARD.

THE search for mines probably engages more of the time and labour of mining men than even mine administration. Every mineral region of which I have personal knowledge is, and has been for years, over-run with engineers, promoters, and prospectors looking for opportunities. On every hand are people with mines for sale. In a single day, in any mining centre, one can collect an armful of pocket-worn, unsigned reports, which, if not barefaced exaggerations, only mention the favourable details.



Mexican miner at work.

In spite of the abundance of mines, each one of which (it is claimed) only requires capital to make it one of the great bonanzas, it is safe to say that, since the boom days of Western Australia and South Africa, those countries have not yielded a half-dozen each of new and large dividend-payers. Mexico does not produce one new large mine in a year. Most of the more recent mines have been found in Alaska and the desert regions of America in virgin territory. In general, what is said here applies to all of the mining countries. The search for mines in Mexico, however, has peculiarities common to Spain and South America, owing to the language and character of the people.

In looking for mines in Mexico, the seeker must disabuse his mind of the idea that it is anything like a virgin country. When Cortez came to Mexico, he found the natives rich in gold. The Spanish invaders discovered their first mine in 1522. For the 387 years since then, Mexico has attracted more attention than any mining region in the world; for 300 years it was carefully exploited by the Spaniards, with every facility from both the Government and the Church. Both military protection and money were supplied from these sources. In Western Australia and South Africa, the active period of discovery lasted about ten years, yet in Mexico interest has been kept alive for nearly four centuries. Since about 1700, Mexico has been exploited by Englishmen, with the backing, at times, of an enthusiastic British public. This enthusiasm was carried so far as to be followed by severe reactions. Since about 1870, the country has received a great deal of American money and, since the placing of El Oro, Dolores, and Esperanza on the London market, Mexico has again been systematically searched by Englishmen.

The collapse of the Australian and African booms, along with others of minor importance, has made the English people over-critical of mining shares, and the peculiar facilities for blocking out ore in the present state of the Australian and African mines, have made English companies over-exacting as to ore reserves. The result has been to give the Americans most of the good mines of recent development. Many mining swindles have been perpetrated in America, but the whole people have never become so wrought up over any particular mining district at one time as the English people were over Western Australia and South Africa. A healthier attitude, therefore, exists in America toward mining than in England.

During the waves of English and American enthusiasm for Mexican mines, no discrimination was shown. Anything in the semblance of a mine that could be bought, optioned, or located, and some that did not exist, were floated. Many people were fooled and, as in a lottery, a few drew prizes. With each revival of interest in Mexican mines, the country was investigated thoroughly by intelligent and capable men. Very little in the way of real mining was overlooked. The question naturally arises: Why are we looking for mines in Mexico to-day and what are the elements that make for success or failure in this search?

The reason for all this is that the world likes to gamble; the stakes of mining are large and the game employs many serious men, educated in universities and trained in the practical pursuits of geology and metallurgy, for the sole purpose of eliminating chance as far as science, human judgment, and centuries of accumulated experience make it possible. It is evident that the opportunities in mining are sufficient to warrant the search, otherwise those so engaged would fail to get financial support.

The following are the causes that permit opportunities for winning big stakes in mining in Mexico, even after 387 years of European exploitation and exploration:

1. Retirement of mine owners for various reasons, including death, old age, family disputes, financial distress, lack of capital, and mismanagement.
2. Amalgamation of ownership and management.
3. Increased knowledge of ore deposition.
4. Improvements in metallurgy.
5. Electric power transmission.
6. Development of the gas plant.
7. Improved transportation.
8. Pacification of hostile Indians.
9. New discoveries.

Opportunity is often a question of good fortune in being on the ground; a mine that has been working quietly for 50 years may suddenly be for sale at a reasonable price, owing to mismanagement of the property or to financial distress of the owner, due to some cause foreign to the mine.

At the outset, it is well to assume that mines having a good showing at the surface are rarely available. Throughout the mountains of Mexico, one finds prospectors holding titles to mining claims. These men are from all parts of the world; they are usually without means, being supplied with provisions and money for mineral taxes from the savings of relatives or friends while waiting for a railroad to tap their district, or for some traveller to come along with the money to develop a mine. They usually wish to retain an interest in their property, which has become glorified by an imagination stimulated by solitude.

Next come the ancient mines, or *antiguas*, the workings of which are inaccessible through caving or accumulated water. It will be said by the seller of an *antigua* that the mine contains a large amount of low-grade ore and that under the water the vein is very rich, but that the former owners could not handle the water owing to lack of capital or mismanagement. Anyone sufficiently impressed by the seller's story to take an option on the mine and unwater it, will often find that the only bit of truth was that the mine contained water. If one speaks Spanish and the mine has not been idle too long, the condition of the bottom of the mine can be ascertained by questioning the old residents of the district, most of whom are likely to prove simple and straightforward when out of the seller's hearing. In this manner I have frequently discovered workings that had been entirely hidden by the owner.

When Humboldt wrote of Mexico, at the beginning of the nineteenth century, he stated that there were about 500 silver-producing mining camps, comprising about 3000 mines. From this an idea can be obtained of the number of *antiguas* in Mexico and of the length of time that it would take to acquire first-hand knowledge of them all. In Mexico, as elsewhere, most orebodies do not go down more than from 600 to 1000 ft.; on account of the shallowness of the pay-zone, most of the *antiguas* are worked out. Many unscrupulous promoters float only this class of mines, because they can secure them on easy terms at a low figure. Such old mines appeal to speculators through their history, particularly with a few flamboyant touches. The development that is done upon them by 'wild-cat' companies is useful in that it serves to furnish the geologist with material for constructing theories. The geologist, by carefully studying those mines that continue in depth and comparing them with those that fail at a shallow depth, can, by analogy, learn to select the 'prospects' that offer the best chances of becoming productive mines. That there are hundreds of rich orebodies hidden by caps of lava or by poor 'gossans,' is beyond doubt.

Many rich mines have been discovered in the deep ravines where streams have eroded through the mantle of eruptive rocks that overlie three-quarters of Mexico. El Oro was discovered in such a manner. In Pachuca, the best ore-shoots of the Santa Gertrudis, Barron, La Blanca, and Real del Monte, now of a combined value of several million pounds sterling, were first found at a depth of about 600 ft. The Sirena mine, at Guanajuato, showed its largest orebody at a depth of about 1500 ft. Many of the lead-silver mines of Mazapil, Mapami, and other districts in the limestone belts, showed only iron stains, under which were hidden a series of cavernous spaces partly filled with lead and silver minerals. A large amount of prospecting can be done with diamond-drills. This form of prospecting has not been used sufficiently in Mexico.

There are opportunities in Mexico for buying, leasing, or locating a number of properties in the same district and combining them into a group for working with one central cyanide plant or smelter. Such an enterprise cannot be established upon the basis of ore reserves but only upon the judgment and business acumen of the engineer. The properties must be appraised on the probability of their orebodies continuing; there are many producing mines in Mexico that have never been 'developed,' in the English sense of the term, but which have yielded ore for years and which will undoubtedly continue productive for many years to come. An extreme example of this is the Guadalupe de los Reyes mine in Sinaloa. Ward, the English writer, who visited this locality in 1825, states that a party of foreigners offered one million dollars for a three years' lease of the property. This offer was refused; the mine was undeveloped then and it is to-day practically working from hand to mouth; yet it has produced continually for 102 years. The owners to-day would probably refuse several times the price an English company would give them. About three years ago I was offered for 6,000,000 pesos a certain mine that could not show a hundred tons of the class of ore it was then yielding. The owners were working entirely by underhand stoping from the bottom level in advance of shaft-sinking. This mine still continues to produce from one to two million pesos annually.

The owner of a mine, with sufficient capital and administrative knowledge of mining to develop his property ahead of his stoping requirements, is too intelligent to option or sell it at a price that will leave the buyer sufficient margin for flotation by public subscription. The capitalization of a flotation must include allowance for buyers' expenses in searching for the mine, engineers' reports, company organization, purchase of property, working capital, and commissions for the promoters and underwriters who advance the purchase money and working capital. One can readily see that the purchase price must be small in proportion to the capitalization, except in the case of a properly equipped and producing mine, for which flotation is illogical and unnecessary. There are many mines in Mexico that can be bought for less than the net value of their ore reserves; such mines are usually those that look lean in the bottom and have therefore been developed for sale, the owner considering it more profitable to sell the mine than to equip and work it. A Mexican mine with ore reserves is generally not a good purchase, because the owner, in his calculations, invariably over-estimates the tonnage in sight and under-estimates the amount of capital required for equipping the property for production; therefore his price affords no basis for good business.

The really golden opportunities for capital in Mexico lie in geological prospecting on a large scale. The practical geologist becomes more useful than the engineer who is not a geologist; this fact is recognised by American operators, like the Guggenheims and the big copper companies, who employ mining geologists to make their examinations.

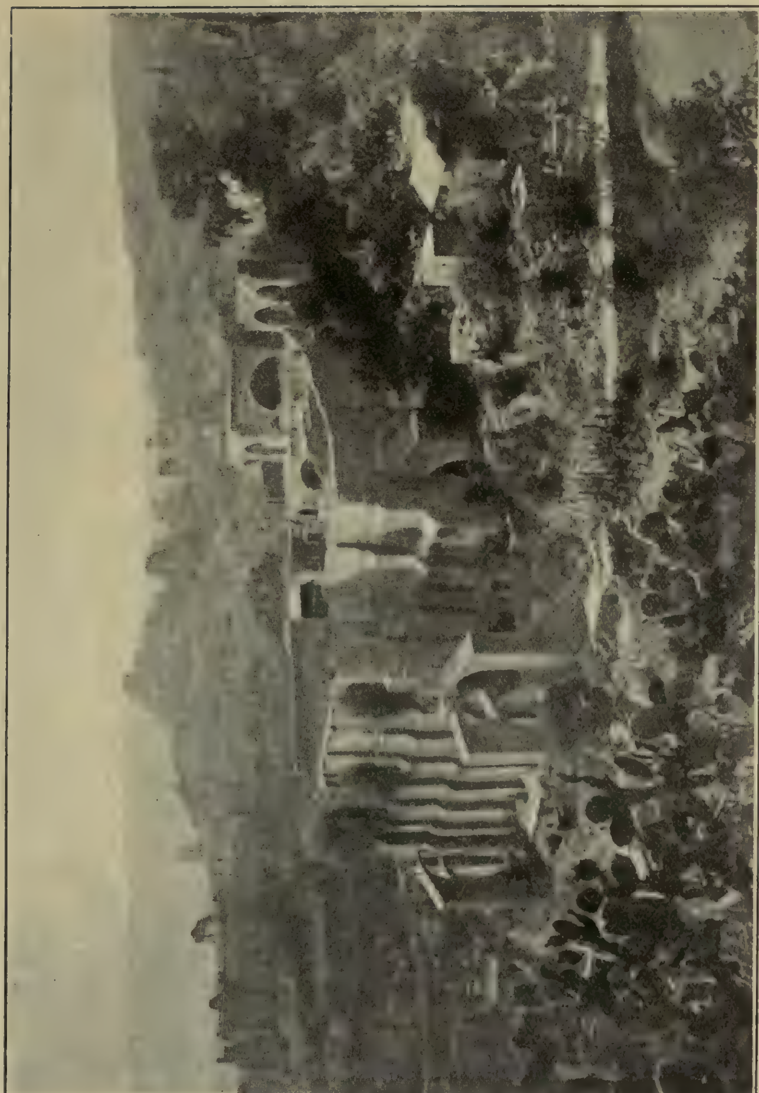
Many American operators are prepared to buy mines on the probability of continuation of the orebodies, disregarding the lack of reserves. Such operators depend upon their engineers to instruct them in the most simple and direct manner concerning the probable extension of the orebodies, the economical rate of development, the probable rate of profits, the best type of plant, and the amount of working capital required. Americans have been successful in Mexico, since, as the Mexican mines lie in a continuation of the mineral belts of Western America, their peculiar characteristics are better known to American operators.

Opportunities exist in Mexico for the man with a little capital and a knowledge of Mexican orebodies. Such a man, by learning the language and customs of the country, can remain in the district long enough to make local alliances, gaining knowledge concerning properties such as the highly salaried company representatives have no time for. When a good mine is secured, the necessary working capital can easily be found by the formation of a small syndicate or close corporation among friends, so that underwriters' fees are eliminated. There are also opportunities for those who come to Mexico with sufficient capital for 'taking up' several undeveloped properties, paying for them in cash when necessary, under a flexible programme enabling them to engage in any kind of mining or metallurgical enterprise that may present itself. I have represented companies, here and in other parts of the world, that were looking for a certain kind of property to be floated at a certain minimum figure. The rigidness of the programme with respect to development, future prospects, and terms made business impossible. The search for such a property threw many opportunities in my way of which I could not take advantage. With a different programme, my principals might have made a variety of successful small operations which would have, at least, defrayed the expenses of searching for their ideal. The case might arise of a company taking a property for development with a view to flotation and the property might not develop as hoped; the programme of the company should then be to work the property for what could be extracted from it, and not to persist in the flotation. Properties for sale are not, as a rule, sufficiently developed for immediate flotation; they must first be developed and some risk taken of their not coming up to expectations. Usually the risk of losing money on the venture can be avoided, since a mine taken for development necessarily contains an orebody. The cash outlay and a profit possibly may be recovered from ore developed. A prospecting and development company, with a liberal programme and operating on a large scale, has nothing but bad management to blame if it loses money. The chances are excellent for making large profits.

As I have said before, most of the good Mexican properties fall into the hands of Americans; the same may be said of the worthless ones. The latter are sold to the innocent by irresponsible American brokers; there are cases of brokers unwittingly floating good mines, but, being entirely ignorant of mining, they disposed of all the treasury stock without providing working capital. They generally ruined the mines in the attempt to work them without capital. Most of the good mines, however, are bought by successful mine operators who understand mining and know the conditions that exist in Mexico; these are always ready to "scuttle the ship" when hope is lost, preferring a new prospect to an old one. Such operators send engineers to Mexico who know the ore formations, as well as the language and customs of the people with whom they are dealing.

Many English companies have been formed in recent years to search for mines in Mexico. They have expended money lavishly, employing engineers who have been successful in other parts of the world. Owing, however, to lack of knowledge of Mexico on the part of both the company and its engineer and to lack of adaptability in the company's programme, practically none of the recent English mine-finance companies have been successful. This is not in keeping with the history of the English people abroad in either trade or mining. As far back as the eighteenth century, many large fortunes were made by Englishmen in Mexico, at a time when the difficulties to be overcome were innumerable in the way of danger to life and property, lack of transportation, and scanty knowledge of metallurgy. In those days, the local representative was not in cable communication with the London office; he was left to his own resources in urgent matters. History does not record whether or not he came to the country with instructions to look only for developed mines, concerning the value of which the owner was ignorant, that could be bought for a small percentage of their value on the London market. The results lead one to believe that he came to Mexico only to buy or lease mines for the purpose of working them for profit under the existing conditions of the country. Assay-plans or ore reserves were unknown in those days. Syndicates and companies were formed in England, and they sent out hardy men on whose judgment they relied. This confidence was not always properly placed, of course; but when it was they got results. In those days communication with the mine for reports or bullion required months of travel by boat over seas infested with pirates, and by mule over lands infested with bandits.

During nearly four years spent in Mexico, I have never met a representative of an English company who was not looking strictly for large developed properties with ore reserves and good-looking bottom levels. In addition, he expected to obtain easy terms



The old mines of Guanajuato, Mexico.

and to be able to float the property immediately and to make large profits after having provided working capital. This state of affairs arises from a misconception of the possibilities of the country, caused by widely published and inaccurate reports concerning Mexico.

The representative of English mine-finance companies coming to Mexico readily secures letters of recommendation to bankers, lawyers, government officials, and mine promoters; each of these letters will bring him into touch with people who claim to have special relations with the President and other high officials. The fact that everyone who goes to President Diaz with a deserving business proposition gets a gracious hearing might give the visitor an exaggerated opinion of his own influence. He will find himself bewildered by the number of people who have for sale just what he is looking for. He will plan a trip with one of these gentlemen. Thus two fools will journey several days by rail and mule. One fool is thinking that he has at last found a person green enough or unscrupulous enough to buy a mine that the owner knows has reached the limits of its orebodies. The other fool is thinking that he has perhaps found a man with a mine that can be bought for less than it is worth to the owner, whose facilities for working it profitably are probably greater than those of the foreign company. The seller returns telling his acquaintances—so as not to injure his chances for trying the mine on another—that the company's representative is incapable and does not know a good mine when he sees it. The buyer finds out that the mine has previously been examined by several well-known engineers and that his newly made friend is a liar. The lying is kept up consistently. At the mine the lying becomes more specific. The owner will point to faces of vein-material and state fictitious values which the buyer can only disprove by sampling. The buyer hurries to his headquarters to repeat his experience, wearing out both his patience and that of his principals, travelling by day and night to keep his appointments with other liars, still hoping to get a rare chance. The seller returns to his hotel lobby to grow fat until another mine-hunter arrives with the proper credentials.

All of the new arrivals in Mexico, unless they know the country from previous experience, go through the same process and their mission comes to the same futile end. During the last few years I have represented, in the capacity of manager or attorney, 22 English companies and have some knowledge of their methods. I am writing this article solely in the hope of being able to furnish such information to English operators as may aid them in making a profitable expenditure in Mexican mining regions.

To my mind the failure of most of the English mine-finance companies in Mexico is caused by the exacting demands of the English public and by a meritorious effort on the part of reputable company directors to give their shareholders what they want. In 1901, the English public awoke from an unparalleled period of gambling in South African and West Australian mining shares. Mines had been valued by the monthly output reported in ounces of bullion. Instances were not uncommon of a falling off in the amount of bullion being made up by adding base metal to the melted gold in order to prevent a break in the company's shares. Working costs and metallurgical results were ignored; ore reserves estimated, in many cases, by the tools of market operators, fluctuated to suit the share-books of the master operator. It was at a time when this state of affairs had reached its climax in West Australia that H. C. Hoover, then a partner in the firm of Bewick, Moreing & Co., engaged me from California, where I was profitably working a 4 dwt. gold property, and told me that it was his desire to have a campaign for low working costs started in West Australia. With the co-operation of F. A. Govett, who had recently been made chairman of the Lake View Consols and Ivanhoe mines, I started the campaign for economical management at Kalgoorlie, as resident manager of the Lake View Consols. Within a few months, the working costs on that mine were reduced almost a pound per ton and the residues were meantime reduced by nearly 70% of their former assay-value. Many thousands of tons of hitherto unpayable ore were thereby made payable and a new life given to the mine. We carried the reform in management to all of the Bewick-Moreing group of mines, of which I became local representative, and reform became almost general in West Australian mines. People who had speculated in the shares of West Australian mines and afterwards considered their money almost lost, suddenly found an unexpected relief in the results obtained by the economical administration of their mines. Exact estimates of ore reserves and reduction of working costs became the order of the day. J. H. Curle visited West Australia at that time; he happened upon the scene just at the moment when reduced working costs and improved metallurgical extraction had so enhanced the value of ore reserves that several mines had come to have more profit developed than the value of the total stock of the company on the London market, depressed by recent disasters. Other mines had large percentages. A great deal of attention and editorial comment was caused by the figures published by Mr. Curle, in which he showed how such mines could be regarded as investments. He advised the public to buy shares in dividend-paying mines that were developing favourably in the bottom levels and had 60% of their market-value assured by their ore reserves.

Events in Africa were paralleling those of Australia at this time. Re-grinding of sand from the stamps, a process adopted successfully for the reduction of costs and residues in Australia, had been taken up on the Rand with good results. Re-estimates of the ore reserves there also were necessary to meet the public's new demand for details. Curle's scheme for eliminating the risk in mining took great hold of the English public and effectually checked gambling in mining shares, because speculators adopted the same limit both for buying and selling, so that no sales resulted. People jumped from the very extreme of reckless gambling to the very extreme of conservatism. It is proper to apply conservatism to any investment or speculation, but extremes in anything cause the necessity for later re-adjustment. The present attitude of the English public is the extreme of favouring mining only when it is an investment; to them a mine is an investment only when its possibilities for disaster are eliminated and its orebodies are developed. A developed mine rarely possesses great opportunities for new discoveries; it therefore lacks the allurement of a favourable undeveloped property, which might be classed as a speculation. If only mining 'investments' are to be endorsed, we must in future confine ourselves to the mines that are now developed. This would kill the mining industry. Such a contingency is, of course, absurd. Curle found a rare moment for applying his scheme, and only those who got in first were able to take advantage of the opportunities then offered. The public is now so well informed by publication of cables and reports of all of the most reputable companies that such opportunities as existed then for investment along these lines are not likely to occur again.

Zacatecas, Mexico.

Previous to 1901, most of those who bought mining shares were not particularly interested in the welfare of the mine itself; they watched the pulse of the market and bought when they thought the master gamblers were going to force the price up by rumours or cables from the mine. They hoped to be able, in some miraculous manner, to know when to unload their shares upon some more optimistic or less informed person. The game worked well while the mines were in their developing stages, when unexpected new discoveries were frequent. But, like a crooked game of roulette, when all of the chips were on the table, the green star came up and the master operators, many of whom had been trusted by the shareholders, as directors, to guard their interests, swept the tables clean. At the mines, the tools of the master operators sometimes got their plunder first and basely deceived their patrons. The small shareholders were left with the shares upon their hands and a voice in a disorderly meeting. The industry then fell into the hands of the reformers, or, as they say in America, the 'muck-rakers.' Under the new régime, directors became angels of propriety; shareholders were given permission to visit their own mines, from which they had hitherto been excluded; telegrams and reports were published immediately upon receipt.

Virtue is commendable, but the public refuses to forget the past and to make a promiscuous market in mining shares. Some people are so bitter that they will not now support new enterprises of exploration and development; they have lost their confidence in their ability to select honest directors and engineers. This is a condition for which the mining profession ought to devise a remedy. There is evidently plenty of money available at a time when the greatest nations of the world are fighting for a Chinese loan. Plenty of worthy mining ventures are available. While the mining profession is rusting, a few wealthy mine operators are gaining a monopoly over the mines and metals of the world. Old established mine-finance companies are looking frantically for developed mines that will suit the mood of the public, in order to revive the mining market, and thus obviate the necessity for their own liquidation. Many professional mining men, owing to lack of professional work, have turned promoters and they too are looking for developed mines, the chances for finding which, as I have endeavoured to show in this article, are almost hopeless.

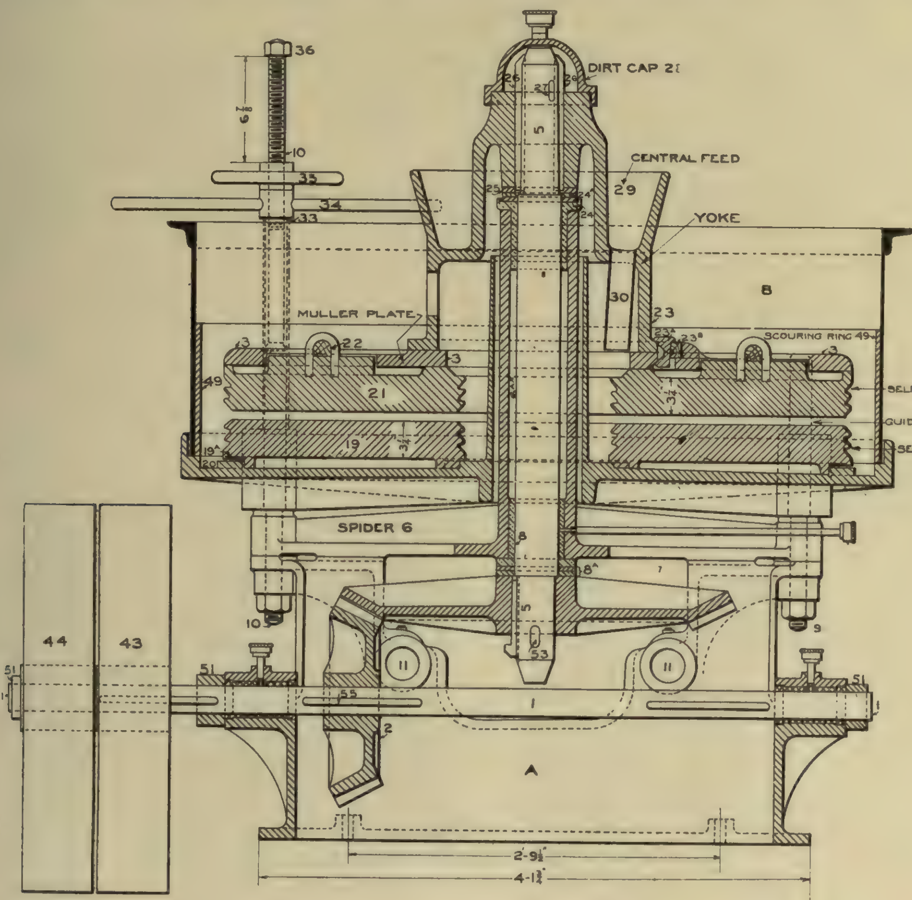
Mine-finance companies would be more successful if they would begin to look more strenuously for favourable prospects and endeavour to make *mines* instead of working the *markets*. If they should make and work a few good mines, their own shares would become valuable and fewer new flotations would be necessary. All professional men would like to see the public look upon mining shares as titles to property instead of gaming chips. Should a mine become worked out or become unpayable, the shareholders should take the consequences and not, by lying rumour and false reports, endeavour to unload their shares upon the less informed public. It is a great calamity that the English public, noted for its caution and business enterprise, should have been frightened out of a field so attractive as mining by disasters resulting from a lapse from its customary vigilance. It is time that the qualified mining engineers in England should take such steps as are necessary to restore and maintain the public confidence in mining enterprises.

Aluminium Coinage.—It is expected that the commission appointed by the French Minister of Finance will recommend the issue of aluminium coins to take the place of the present nickel and copper currency, and already specimens have been issued for the purposes of experiment, trial, and criticism. Copper coins have not been minted in France for over two years, and the 25-centime nickel coins introduced recently are by no means popular, owing to the difficulty of differentiating them from silver coins in artificial light. It is probable that the copper and nickel currency will be withdrawn, and aluminium coins to the face value of £2,000,000 substituted for them.

Mining and Metallurgy in West Australia.—It is announced by the Chamber of Mines of Western Australia that a book is shortly to be published on 'West Australian Mining Practice' by E. D. Cleland. This publication will be based on the series of articles recently appearing in the *Monthly Journal* of the Chamber, and will include additional information on recent geological investigations at Kalgoorlie. The Chamber's other publication, on 'Metallurgical Practice,' is at present out of print, but a revised edition will be published if sufficient forward orders are received.

The Cobbe-Middleton Pan.

In the earlier days of Kalgoorlie, grinding and amalgamating pans of the Wheeler type were used to advantage, but the development of this method of extraction was generally neglected, and the tube-mill process superseded it. The only engineers who have persevered in the application of the pan to Kalgoorlie ore are H. N. G. Cobbe and W. Middleton. Their improved pan is doing such good work at the Hainault mine as to warrant a description of the machine and its application in Western Australia.



The Cobbe-Middleton pan differs in several ways from the Wheeler pan. The muller is supported on a spindle and rotates in a fixed plane, while the pressure between the shoes and dies is obtained by the operation of weighted levers that press the loosely mounted body upward. Referring to the accompanying vertical section, the muller plate (3) shod with shoes (21) is attached by means of the yoke (23) to the central spindle (5), which is rotated by bevel gear and belt. The body of the pan is held by guides (9), up and down which it can slide. By means of a set of cranks, levers, links, toggles, and weights not shown in the illustration, the pan is held up so that the right amount of pressure is obtained between the dies (19) and shoes (21). The gear is mounted on the fulcrum shafts (11), which are shown in section in the figure. This system of levers is designed to render the pressure constant however much the dies and shoes are worn. In a Wheeler pan the compensation for the wear of the shoes and dies is effected by the occasional addition of weights to the muller, so that the pressure cannot be constant. It will be seen that the Cobbe-Middleton arrangement provides an improvement as regards uniform pressure. When it is desired temporarily to release the pressure between the shoes and dies without stopping the muller, the body of the pan can be depressed by rotating the hand-wheel (35).

This wheel, being arranged at the side of the pan, can be more easily operated than the wheel at the top of the central spindle of a Wheeler pan, which it requires a gymnastic feat to turn. The shoes and dies of this new pan are in the form of sectors of a circle with curved radii and are set slightly apart. They also have radial fillets on the under side of the die and on the top side of the shoes, to direct the current in such a way as to cause an active spiral circulation of the pulp. The peripheral edges of the shoes and dies are formed with corrugations, as in the section. In this way the projecting edge caused by imperfect centreing of the shoes and dies is abraded with wear, instead of forming awkward circular ridges. The wear of shoes and dies costs 1¾d. per ton of ore treated. The feed is central (at 29) and the discharge-screen is approachable on both sides, a great advantage in the removal of chips and other foreign substances. The pulp whirls round the pan, and does not strike the screen at right angles, as in a battery-screen. The mesh of the screen is therefore no guide to the fineness of crushing; as an example, it may be said that a 15 to 16-mesh screen is used for producing a 40-mesh product.

At the Hainault mine these pans have been at work for just two years. There are six of them, of which only five are regularly at work, the other being held in reserve, and they reduce the ore crushed by 40 stamps from 8-mesh to 40-mesh actual. Each pan consumes 7 h.p. for driving. No amalgamation is done in the stamp-battery, nor is the pulp sent over plates before going to the pans. The amalgamation is done in the pans during grinding, a complete intermixture of the mercury and the pulp being obtained. From the pan the amalgamated pulp is discharged over plates, which are merely supplementary. Until the introduction of these pans, the tailing from the stamps was treated on tables in order to recover the pyrite and telluride, and the concentrate was sold to smelters. According to the new arrangement the whole of the ore is treated on the spot. The tailing is classified into sand and slime; the sand is concentrated on Wilfley tables and the slime on canvas strakes. The products from the different concentrating tables are roasted in Edwards furnaces and subsequently cyanided. During August of this year 5544 tons were treated with a total recovery of 27s. 9d. at a cost of 18s. 9d., leaving a profit of 9s. per ton. When the new tailing plant is in full working order the extraction will improve.

What is a Mineral?

Since writing the short article in our issue for September relating to a case before the Court of Chancery where the owners of the mineral rights unsuccessfully claimed compensation for the excavation of clay that was of no commercial value, the question "What is a mineral?" has been almost continuously before the public in connection with the new taxation proposals. At first the Government was disposed to include every constituent of the earth's crust that is not actually used for agricultural purposes or excavated during building operations, but finally for some reason not quite clear, clay used for the manufacture of building bricks was excepted.

In this connection it is of interest to note that in the United States the English rule of 'widest signification' has been adopted in framing the legal definition of 'mineral.' Everything is included that possesses a value for use in trade, manufacture, the mechanical or ornamental arts, and which can be won and marketed at a profit. Not only are all possible real minerals included in the definition, but a number of doubtful substances are classed as such; for instance, resin and amber. Curiously enough brick-clay forms an exception in America, even though proof of its profitable nature may be adduced. It appears that an old decision gave an erroneous ruling, and it has been illogically taken as a precedent ever since. There are naturally exceptions to the hard and fast definition of a mineral; for instance, when the contract in dispute contains some definite construction of the meaning and application of the word. This practice is precisely similar to that seen in the case of the 'china-clay' dispute in Cornwall recently, where the word 'mineral' was restricted to the meaning according to a certain Act of Parliament.

Alaska.—Absence of high winds is a notable feature of interior Alaska; the quiet atmosphere gives a charm to the long summer days and mitigates the severe cold of winter.

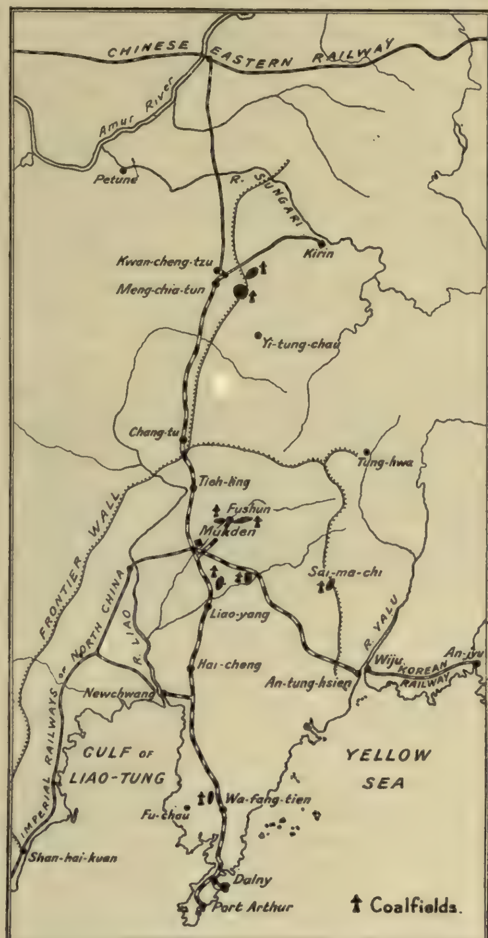
TINOL is the trade name of a mixture of granulated solder and an oily flux that is now finding acceptance in Germany. The mixture is applied cold to the joint by smearing it with a knife or by the hand. The heat of a flame, a soldering iron, or an electric current melts the solder and gradually volatilises the flux. In practice this method of applying solder and flux is found to be rapid and economical.

COAL MINING IN MANCHURIA

By THOMAS T. READ.

SINCE Japan and Russia, calmly ignoring the sovereignty of China, made of Manchuria a bone of contention culminating in the recent war, that province, naturally rich but long overlooked, has gained enhanced importance in the eyes of the world. And China, with neither the foresight nor the power to safeguard her valuable possessions, seems destined in the near future to lose entirely this valuable area unless the not unnatural desire of the rest of the great nations to share the commercial possibilities of the province shall operate to prevent it from passing entirely into the hands of Japan and Russia. Manchuria is valuable in many ways: to Russia as a Pacific gateway to her vast Asiatic possessions; to Japan as an outlet for her overcrowded population; to the other nations as a region of large agricultural and mineral possibilities. With such conflicting interests it is difficult to predict what changes may ensue during the next decade.

Manchuria, with an area of 365,000 square miles and a population of 8,500,000 people, or less than 25 per square mile, occupies the extreme northeastern corner of the Chinese Empire. It is bounded on the north and west by the Amur river, which separates it from Siberia, and on the west by Mongolia. On the east are the Primorsk province of Siberia and Korea; and on the south is the Yellow Sea. Politically it is divided into the three provinces of Fengtien, Kirin, and Heilung-kiang, but physiographically it is divided into a northern region, drained by the Sungari, and a southern, drained by the Liao river. Except for the plains of these rivers the entire region is either rolling or mountainous. The northern part is the more extensive and is fairly well forested; the southern part is better watered and supports the larger part of the population. Manchuria derives its name from the former inhabitants, a race still dominant in China, although in Manchuria itself they constitute less than 10% of the population, more than half being Chinese. Ten or a dozen different tribes of Tatars and Mongols make up the remainder, together with some Russians, and a number of Japanese, who have come during the last few years. There is also a large floating population, as each year thousands of labourers arrive from China, returning to their homes in the autumn. The list is not complete without mention of the Hunghutze, the descendants of former Chinese gold-seekers, who, failing in their quest, turned brigand and now ravage the country, especially in the north. These the Chinese soldiers seem en-



The Coalfields of Manchuria.

tirely unable to suppress, preferring to come to a "gentleman's agreement" with them.

With a sparse population in a wooded area there was naturally little demand for coal in Manchuria until recently. Even when the Chinese Eastern railway was constructed the Russians employed wood-burning locomotives so that the use of coal was not much increased.

But when the Japanese obtained possession of the southern half of this railway at the end of the war, they rebuilt the road, equipped it with high-grade American rolling-stock, and proceeded to explore the neighbouring coal-fields and to develop the best seams. In consequence of this activity we now possess fairly accurate ideas concerning the coal resources of Manchuria.

Briefly, coal is widely distributed but is little developed for lack of demand. The South Manchurian railroad has opened up a large mine near Mukden for its own purposes and some of the coal is also sold in the open market. As the agricultural and commercial resources of the country become developed there is little doubt that many other mines will be opened up.

The Fushun mines lie about 25 miles north-east of Mukden and are connected with the South Manchurian railway by a branch line 34 miles long that parallels the river Hun and joins the main line at Su-chia-tun, a short distance south of Mukden. Fushun is the name of a small town on the opposite side of the river from the coal mines, and the coal is exposed on the edges of the hills that front the river on the south, from about four miles west of Fushun to about six miles east, or ten miles in all. Apparently the coal has been worked from very early times as an adjunct to the manufacture of pottery, for in making excavations for the present plant large quantities of pottery of ancient Korean design and coins of early date (300 B.C.) have been discovered. When the Russians were operating the Chinese Eastern railroad they also developed these mines, but only in a small way, and the production was slight. Development in its present form dates from the Japanese occupation.

The hills that rim the Hun river to the south are of gneiss, which is overlain by the Tertiary strata that contain the coal. The dip at the western end is 23° and increases up to 32° at the eastern end. The coal is a soft bituminous, approaching lignite, and resembles many of the coals of the Rocky Mountain region. It is sharply contrasted with the rest of the Chinese coals, which are Carboniferous or Jurassic. It is difficult to say whether there is only one seam, with numerous thick partings, or 60 to 70 seams closely associated. The total thickness of coal is often as much as 270 ft., and is generally more than 150 ft. A report of the company describes it as consisting of two seams, though in my inspection of the workings I was unable to distinguish more than one. The greatest thickness found without a parting is 32 ft. and the five seams from which present production is maintained average 9 to 12 ft. each. A sixth lower seam, recently discovered, is also to be worked. Only the cleanest and best parts of the seam are extracted.

The present production comes from shallow shafts and inclines on the outcrop; the systematic exploitation will be from two large shafts, which intersect the seam at about 1000 ft. and are expected to have an output of about 2500 tons per day each. The mine is now producing 2000 tons per day from two incline shafts, each of which supplies 400 to 500 tons, and two vertical shafts, each of which yields about 600 tons. The total production for 1908 was 437,000 tons, but, as the daily production at the end of the year was about double what it was at the beginning, the production for 1909 will probably exceed 700,000 tons.

The five seams now being worked are mined by the pillar-and-stall system. The coal is soft and readily cut with a pick, so no powder is used. When freshly cut it furnishes a large percentage of lump, but being friable it breaks up badly with handling. It also slacks on exposure, but it is so free burning that its excessive fineness does not interfere with combustion, the fact that it does not cake being also of assistance in this regard. The seam dips north at 30°, and the coal can be easily handled in chutes, but, in order to guard against it breaking up too much, self-acting planes are also used. The enclosing shale is soft; only jumper drills are used; but the roof stands so well that scarcely any timber is required—which is an important item, as timber is expensive.

The miners are chiefly Chinese, who work by contract, their average earnings being about 40 to 60 sen per day. This compares well with the average earnings of Chinese labourers (18 to 25 sen per day) throughout the Empire. The production per miner per day is about 1⅛ tons. Japanese are employed chiefly as skilled labourers and as supervisors. They receive from 1 to 3 yen per day (1 yen is a little more than 2 shillings). The miners prefer to work by contract. Two shifts are employed underground, the actual working time being 10 hours. The company furnishes quarters for all the employees. The Chinese live in a sort of barracks, 72 to each house, the occupants of a house contracting with a cook to furnish them with food, and also engaging a watchman to look after their belongings while absent. No difficulty is found in securing a sufficient supply of unskilled workmen and of miners, and it is easy to import skilled labourers from Japan. The company maintains a school for the children of the workmen, and provides a hospital.

No gas is encountered in the workings, but as the dust is very inflammable safety lamps are employed. These burn bean oil, which is satisfactory, and is the cheapest available. The Chinese miners are fond of sitting down and smoking their pipes, and in order to prevent them doing so in the working places the management furnishes them with tobacco on condition that it is to be smoked only in rooms provided for the purpose, which rooms are also used by the miners for eating their food while underground.

guide-ropes for the bucket. The frame is kept at a convenient height for the work of placing the lining, and during sinking a door at its centre is opened, allowing the bucket to pass through and proceed to the bottom, the remainder of the frame serving as a protection for the workmen beneath.

As practically all the rock excavated in sinking has been shale, jumper-drills have generally sufficed, although in some places air-hammer drills have been found necessary. The holes are $1\frac{1}{2}$ in. diam. and are charged with 6 to 8 lb. No. 2 Nobel gelatine. The rate of drilling is 6 to 7 ft. per day; the lining of the shaft is done slightly faster. The shaft is expected to reach the coal in November. The water encountered in the shafts is readily handled with the bucket.

Fig. 1. Main shaft.

Fig. 2. Power-house.

The new development consists of two double shafts; as these are practically identical, only the equipment at the Oyama shaft will be described. The other shaft is known as the Togo. At the Oyama there is an up-cast and a down-cast opening. The former has an inside diameter of 18 ft. and the latter of 21 ft., both being round shafts lined with brick. This lining is 12 in. thick and is built in 80 to 100 ft. sections. During sinking a temporary lining of steel rings (made from bent rails) is employed, to be removed as the brick lining is completed. This is laid in cement mortar, and each section is supported independently by being built into the walls at the bottom. The work of placing the lining is expedited by the use of a timber frame, which entirely fills the shaft and is suspended by steel cables, so that it can readily be raised and lowered. These cables also serve as

The method of handling material at the top of the shaft is noteworthy. The entire top of the shaft is enclosed, except a small central space; this is provided with a sliding cover, which is moved backward and forward by means of a small steam-cylinder. When the bucket is in the shaft the cover is drawn back. When the bucket has been drawn up, it is moved into place, closing the shaft entirely. The bucket is then lowered on to a nick on this frame and it is then drawn back, the bucket detached, and sent away to be dumped. In this way it becomes a practical impossibility for material to be dropped down the shaft upon the men beneath. The hoisting for the sinking operations is done by a temporary geared hoist, which will be replaced, when the sinking is finished, by a larger first-motion hoist with compound engines.

An electric-lighting plant is already in operation. This consists of a number of 500 kw. units, driven by Parsons steam-turbines. Alternating current of 2200 volts is used, and will eventually be employed for haulage and hoisting underground, as well as for lighting. The boilers are Babcock & Wilcox, provided with automatic chain-grate stokers, the character of the coal making it peculiarly suitable for this type of stoker. But where labour is so cheap it is difficult to see what economy is derived from mechanical stoking. A battery of Green fuel-economizers has also been installed—an equally doubtful economy under the circumstances. In fact, the only criticism that can be made upon the management is that large sums have been spent on buildings and expensive machinery when an equal production and nearly as economical working could have been secured at a much smaller outlay. This is a feature that I have noticed in commercial operations throughout Japan; it may be due to psychological rather than business causes.

In Fig. 1 is seen one of the shafts now in operation. The coal is brought to the surface in the half-ton cars and is sent to a tipple. Some of it is loaded direct into cars and sold as run-of-mine; the remainder is sent to a bar-screen and the lump coal loaded into the cars, the fine being used under the boilers at the plant. Fig. 2 shows the power-house at the Oyama shaft, the temporary head-frame of the up-cast shaft appearing in the background at the right and the down-cast just being visible over the top of the power-house on the left. The battery of fuel-economizers is seen at the base of the chimney. This picture is taken from the top of the reservoir, to which the water is pumped from the filters on the Hun river.

Below is given an average of seven published analyses. The coal is non-coking, but works well for gas-production. Gas-plants are being installed both at the mine and at Dalny.

	%
Water	6·30
Volatile hydrocarbons ...	39·34
Fixed carbon	52·90
Ash	3·18
Sulphur	0·72

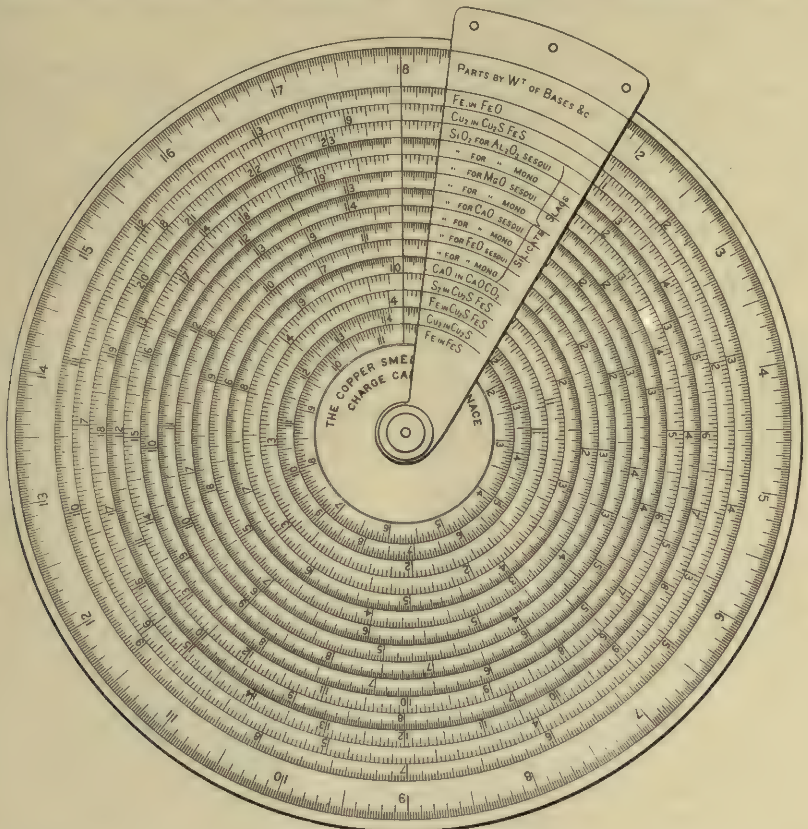
It should be said in passing that this mine is owned and operated by the South Manchuria Railway Co. During the war the mine was seized by the Japanese army of occupation, and was administered by the military government until two years ago, when it was turned into a subsidiary company controlled by the railway. In addition to this mine the railway company also owns a number of other coal properties south and east of Mukden. Of these the principal are at Yentai, Pen-chi-hu, and Wu-hu-tsui, west of Wa-fang-tien. The coal found at these places is semi-bituminous, and occurs in the Carboniferous formation, but as it yields such a small percentage of lump it is only being developed slowly. About 150 tons per day is at present being produced by all three together. At Sai-ma-chi, east of Pen-chi-hu, a Jurassic semi-bituminous coal occurs; but it is not being exploited, as it is too far from the railroad. About ten miles southeast of the terminus of the Japanese part of the line, at Changchun, there are two small mines as yet undeveloped. A Chinese operator is doing a little work at this point. According to Hosie, coal is found at many places in the Kirin province, most of it being brought down the Sungari river. A government mine has been opened at a place 20 miles from Tung-chiang-tze, which is the head of navigation on the Liao river. In travelling over the Trans-Siberian railway I noticed a thin seam of coal in a cut near Pogranitchnia, on the eastern border of Hei-lung-kiang.

The status of coal mining in Manchuria may be summarized thus: Coal occurs widely throughout the area; it is bituminous or semi-bituminous, and of good quality, but very friable, yielding only a small percentage of lump. The small quantity that is required for native needs is mined by native methods adjacent to the points of consumption. The entire supply of the South Manchuria railway is derived from its privately owned mines at Fushun, and in addition it sells coal in the open market, the low cost of production at its mine and the superior shipping facilities enabling it to do so with such advantage that competition is already seriously felt by both Japanese and Chinese mines, which formerly supplied the shipping trade. It should be added that the quality is such as to permit a bid for the trade. As the quantity of coal available in the Fushun field has been estimated at 800,000,000 tons it is highly probable that the railway company will be able to supply all the needs of the Manchurian and adjacent markets for many years to come. What is most needed in Manchuria is the discovery of a really good coking coal, which would then permit of the development of the iron ores known to exist not far from Mukden. This would be the basis for an extensive mineral industry in the province.

Smelting-Charge Calculator.

Much irksome labour is attached to the calculation of blast-furnace slags. For instance, the figuring of the contents of a definite amount of ore from the percentage analysis, or of the amount of each element contained in a certain weight of the matte, flux, or other substance, entails much multiplication and division. Tables have been published for the purpose of simplifying these calculations, but they are troublesome to use. Many metallurgists make tables for their own purposes. The circular calculator invented by Robert Marshall provides a mechanical method of conducting these calculations. We think it will be useful both to the metallurgist and to the student. The latter is often overawed by the subject of slags and blast-furnace charges on account of the dreary series of calculations required, though it is really a simple chemical problem. In calling the problem 'simple,' we refer to the chemical theory; it is the commercial application that presents the difficulties, and requires the training and skill.

The calculator consists of a disc ten inches in diameter. On one side is an ordinary circular slide-rule arrangement not requiring description here; it is used in the present case for calculating percentages. The other side is the subject of this article, and the accompanying illustration gives a better idea than any description. The various circles are graduated for use in connection with the corresponding items marked on the revolving sector. If it is required to find the proportional quantities of the constituents of any given weight of ore, for example, the Cu, S, Fe, CaO, MgO, Al_2O_3, SiO_2, from an analysis of the ore, each figure can be obtained on the slide-rule side of the disc, by multiplying the total weight by the individual percentages and adjusting the decimal point. After having obtained these figures we use the other side of the apparatus. To take a simple case, suppose an ideal matte Cu_2S, FeS is to be formed. Take the circle corresponding to the entry 'Cu_2 in Cu_2S, FeS' marked on the sector and bring it against the figure representing the copper in the charge. The edge of the sector in the division 'Parts by Weight, etc.,' will



give on the outermost circle the figure representing the amount of matte containing this amount of copper. While the sector is in the same position, readings may be made of the Fe and S in the matte. The next usual operation is to subtract the iron in the matte from that in the ore and so find the excess iron in the charge that will have to be oxidized so as to combine with the silica. Set the sector division 'Fe in FeO' to the figure representing the surplus iron, and the corresponding amount of FeO is read on the outermost circle. While the sector remains in the same position, read the figure on the circle against the entry 'SiO_2 for FeO sesqui' which gives the weight of SiO_2 that will combine with the amount of FeO to form a sesqui-silicate. And so on. We have not sufficient space to follow out the remainder of the calculations for finding out the requisite additional fluxes, nor for explaining how the calculations are made when lower-grade mattes are to be produced. We have said enough to suggest how calculations are simplified by means of this instrument.

Electric Smelting of Zinc-Lead Ore.

For two or three years F. T. Snyder has been conducting experiments at Nelson, British Columbia, with a furnace adapted for electrically smelting low grade zinc-lead sulphides that cannot by other processes be profitably utilized. For instance, an ore containing 30% Zn and 10% Pb cannot be smelted at a profit, and in many cases cannot be concentrated. No detailed description of the process employed has been published, so that a perusal of Mr. Snyder's patent 933133, just issued, is of interest. The method adopted by Mr. Snyder is to have two wells of molten lead of U shape, one arm of each well being inside the furnace and the other outside. The two wells are a foot or so apart inside the furnace, and their surfaces and the barrier between them are covered with molten slag. An electric current passes between the two wells of lead, which act as electrodes, through the slag, and maintains it in a liquid state. On the molten slag rests a layer of incandescent carbon. In the roof of the furnace is the entry for the charge, which is gradually fed from a heating-chamber above. In the process of smelting, the ore is first partly roasted, then fed with carbon and flux into the heating-chamber, where it is heated by gases. Here the roasting is completed and also superfluous gases driven off. The ore is continually kept round the entrance to the furnace below, so as to form a seal to prevent the passage of the gases and zinc vapour. The stream of charge is poured gradually upon the layer of incandescent carbon in the smelting-furnace. The reaction volatilizes the zinc, which together with carbonic oxide passes through side ports into a condensing chamber. The lead, on being reduced, falls through the slag into one or other of the wells, and as it accumulates can be ladled from the outside arm of the U. The smelting chamber is thus seen to be sealed against the entry of air, and the necessary heat is supplied by the electric current. The carbonic oxide coming from the zinc-condensing chamber is utilized for heating the charge in the heating-chamber. As the charge is introduced hot, it will be seen that less heat has to be supplied from the more expensive electric source. The study of the slag is an important point, for it is necessary to have a slag combining the three features: (1) high electrical resistance; (2) formation at a temperature between that of the volatilization of zinc and the volatilization of lead; (3) a disinclination to take up zinc. A slag as high as possible in lime answers all these requirements, and in practice it is found that 30% CaO, 30% FeO, and 40% SiO_2 gives satisfactory results. The temperature of the furnace should never rise too high, it should be kept between 1000° C and 1100° C; otherwise the lead will volatilize as well as the zinc. In order to get a good condensation of the zinc, a minimum of gas should be mixed with it. Hence the desirability of using lime in the flux, instead of limestone. We cannot say at the time of writing what success has attended this process.

Murex Process.—In our article in the October issue describing the Murex magnetic process we stated that a certain chemical was used for helping to make a stable emulsion of the oil and the magnetite, but we did not mention what it was, owing to the fact that the patent specification was not published at the time of writing. As the specification has now been issued we are free to say that the substance used is sulphate of alumina. About 1 gallon of 5% solution is found to be sufficient to cause 130 lb. magnetite and 65 lb. thick residual oil to form a mixture inseparable by the magnet. This amount of emulsion would be sufficient to treat two tons of Broken Hill zinc tailing, containing 19% zinc and 5% lead crushed to 40 mesh.

TREATMENT OF SLIME

By HORACE G. NICHOLS

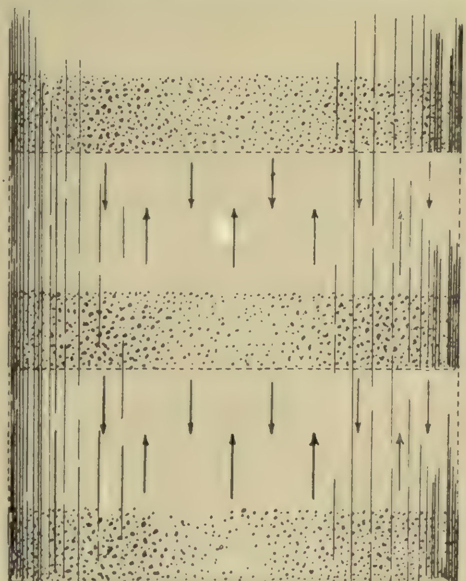
THE complexities attending the treatment of slime all hinge upon that peculiar property by which finely divided solid particles in suspension acquire a virtual specific gravity that is less than their normal specific gravity, and as a result of which they will not readily pass out of suspension. The meaning of this property is dynamically just as unproven as is the nature of the all-pervading link between particles of matter, and a branch of metallurgy so intimately connected with a subject so little understood may well be approached with hesitation.

Lodge tells us that the great force in nature is the *vis a tergo.* Let us start with this assumption and consider our subject from the point of view of an impelling force retarded. To borrow an example from the same authority, the front end of a steel bar must be pulled, before the *vis a tergo* impels the hind end to follow. Evidently there is an obstacle to the free settlement of slime, and it is reasonable to assume that it would be better to remove this obstacle rather than adopt methods of separation that postulate continued suspension. To such engineers as might consider that the complexities attending the practice of vacuum-filtration are unduly great, or that the method leaves something to be desired, a description of a plant recently erected at the Queen mine, in the Sheep Creek district of British Columbia, will be of interest.

This plant is the outcome, on a working scale, of experiments the aim of which was to apply the principle known as acceleration of settlement, due to the removal of fine slime as it settles. This acceleration was first noticed by me when making attempts to withdraw settled slime by means of a conveyor from the bottom of a tank in which a charge had been collected, and the effect upon the rate of settlement was so surprising as to encourage the idea of a continuous process. This object has now been achieved, for the plant herewith illustrated treated pulp at the rate of 100 tons of dry slime per 24 hours.

The main feature of the process is the agglomeration of slime upon the belt. If the settling slime be withdrawn without interfering with the progress of settlement, the increased tendency of solids to pass out of suspension is so marked that this agglomeration permits the withdrawal of the solid particles out of the pulp in a compact form. The device required to facilitate the operation is found in a conveyor travelling upward at an angle of about 18° at a rate of 4 to 6 feet per minute. The inclination and speed vary with the character of the slime handled, and may be adjusted in accordance with the ultimate purpose of the separation.

Before proceeding further it may be well to consider for a moment the explanation of this accelerated settlement. It may be taken as an axiom that the greater the concentration of



solid matter in suspension in a liquid medium, the slower is the rate of settlement; therefore, apart from any other factors affecting settlement, the suspended solids constitute in themselves an element of retardation, or, in other words, retardation of settlement is largely due to the mutually repellent action of the solid particles. Accepting this fact, let us consider it in connection with three imaginary layers, A, B, and C, in a partly settled pulp. As between these three layers there is an upward force acting from A to B, and again from B to C, and downward forces acting from C to B and B to A; so that as far as B is concerned, apart from the force of gravity, it is in equilibrium. If the layer A is removed the upward force A to B is removed and the layer B is free to settle, or is 'free-settling.' The essential factor is the removal of the bottom layer and the withdrawal of each *lowermost solid particle.* Thus a movable bottom to the settling-tank is implied. There is a wide difference between the physical state of the settled particle and that of the one still partly in suspension above it; thus, a scraper working over the bottom of a tank and dragging out thickened pulp is performing a different function from that of a conveyor removing settled slime.

Many different classes of slime have been treated, from finely ground hard quartz to pure clay, but a discharge that is lumpy can be obtained in all cases. The tank is essentially a well or trough set at an angle of 18°, in and out of which a conveyor-belt 2 ft. wide, having flanged sides, travels over 14 in. rollers. The sides of this trough are vertical and are 24 in. high; over them is built a long settling-tank, which at its wide and deep end (over the lower roller) extends to a height of 6 ft. above the trough. This settling-tank is divided into partitions, and nowhere are the sides at a less angle than 65°. The lower roller is set in the well or trough, which is closed at the rear end, and revolves in bearings with stuffing-boxes and removable bushings. The head roller is set on brackets at such a height above the horizontal top of the trough as to allow of an upward travel of 8 ft. above the surface of the pulp. An arrangement of sand-filters set in the tank itself allows the solution to be removed from near the surface (where the pulp is naturally thinnest) to be delivered clarified by means of a vacuum-pump. The sand-filter is set in circular trays of 2 ft. diam., with 6 in. sides, the top and bottom being made of fine screening, which is placed upon the top of an inverted cone, to the bottom of which the vacuum-hose is attached. A simple mechanism attached to the driving-shaft permits a reversal of the vacuum once every two minutes, when a slight flow of solution is delivered under low pressure, cleansing the sand of the slime that has been sucked down into it. Thus continuous operation is rendered possible. These internal filters are not, however, essential to the process. The solution may be drawn off unclarified from the top of the settling-tank and passed through ordinary sand-filters, which can be periodically cleaned without the use of a vacuum at all.

The pulp is delivered at the rear end of the tank, and the solid slime settling out of suspension deposits itself upon the belt and is thereby drawn out of the pulp. The slime falls and is washed off the belt by a spray into a hopper, through which it is discharged into a small air-lift agitator, to emerge as a continuous stream of thoroughly disintegrated pulp. This settling action underlies the practical application of the method. At the rate of 100 tons of dry material per day a ribbon of thick slime 1¼ in. deep is removed on the belt, which, by the time it reaches the head roller, contains no more than 27% moisture.

The feed for this plant was taken from the tailing of a 20-stamp mill after passing through a hydraulic classifier. The whole overflow passed 100 mesh, and 70% passed 200 mesh. This overflow was elevated by a centrifugal pump to two Callow thickening-tanks, from which the discharge (thickened to 15% solid) was run direct to the settling-tank.

In order to obtain a discharge sufficient to demonstrate the capacity and mechanical efficiency of the plant, the washed pulp from the air-lift disintegrator at the head of the belt was also returned to the centrifugal pump and was elevated by it to the thickening-tanks. In this way any desired flow was obtainable, and in order to give the plant a thorough trial, a continuous run was made for 30 hours, handling at the rate of 140 tons of dry slime per 24 hours. In this case the machine was overloaded and a certain amount of the slime layer being discharged by the belt, slipped off the sides and back into the tank. This was done purposely in order to try the efficiency of the means adopted for keeping the tank free of accumulating slime. The method is simple. Two 2-in. pipes are run through the cover of the trough at the rear end, just behind the lower roller, to within three inches of the bottom; the top of these 2-in. pipes extends into a small box built upon the top of the wide end of the tank, through which a hole is bored. The top of the pipes is below the surface of the pulp in the tank. A little air admitted at the bottom of the 2-in. pipes by two ½-in. pipes is sufficient to cause a slight continuous upward current, which has the effect of preventing any accumulation of slime on the bottom of the tank without interfering with the deposition upon the belt, and it was found after the 30 hours' trial that the bottom of the tank was perfectly free from slime.

The sides of the trough were made of wood 3 in. thick, and all the rest was 2 in. thick; the bearings for the rollers were castings bolted down to the supporting 6 by 8 in. timbers, upon which the tank rests. The belt was a 4-ply rubber belt, two feet wide, having flanges

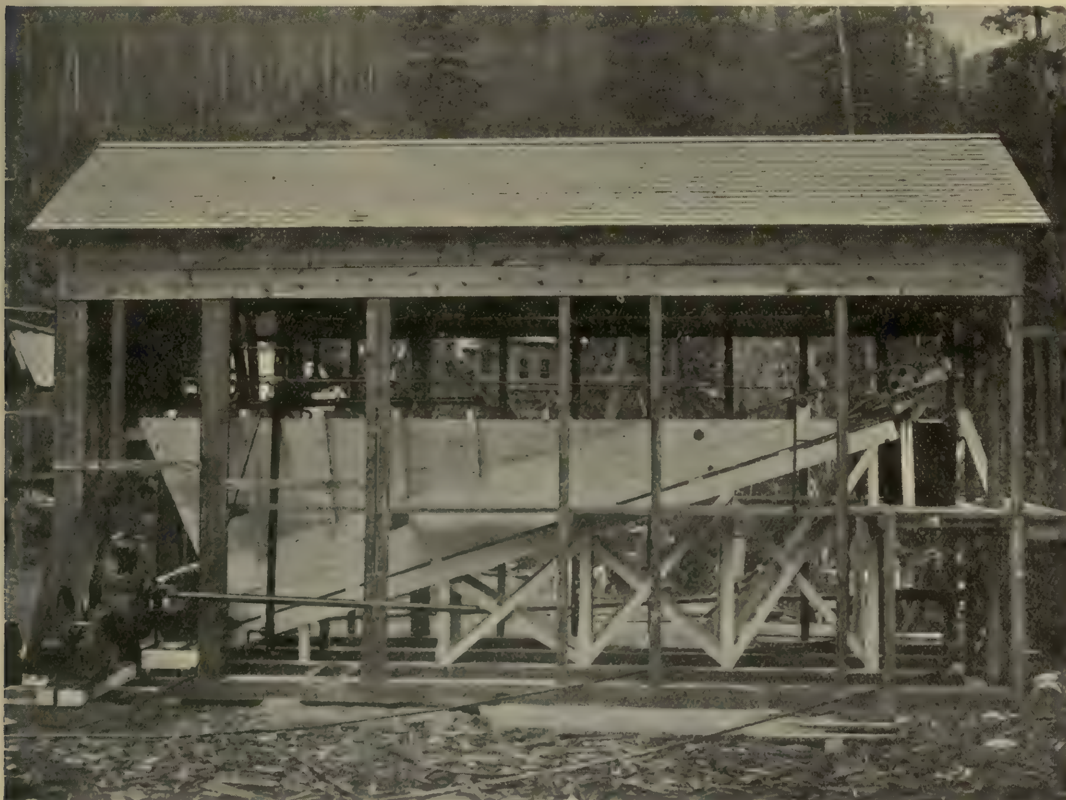
$1\frac{3}{4}$ in. high. These flanges are not necessary, but were adopted in the first plant as being more satisfactory. The cost of this plant, apart from the power and the vacuum-pump, did not exceed £150. As may be judged, the power consumed, and applied to the roller by worm gearing, was slight; 2 h.p. was sufficient to run all the machinery.

The plant was used only as a dehydrator, and to demonstrate the handling of a sufficient and continuous flow of pulp, but the disintegrating and washing air-lift agitator was also used, looking to the applicability of the process to cyanidation. This leads to a consideration of the relative merits of displacement and dilution washing. Aside from any doubt as to the perfection of washing obtainable by known displacement methods, the main feature of decantation practice is the dependence upon calculations as to the extent to which washing by dilution is effected. And in the case of a continuous process, this advantage is more pronounced. The accompanying flow sheet will indicate the manner in which the method may be applied in the case of an ore crushed in cyanide solution.

The process of treatment suggested in connection with washing the slime off the belt may also be gathered from the following example of an ore crushed in water, re-ground, and passed to Pachuca agitators. Between the crushing or grinding machinery and the agitators there would be a slime-settler to act as a simple dehydrator, and the discharge would be washed off the belt with strong cyanide solution and elevated to the agitators.

In such a case there may be 100 tons of ore and 600 tons of water, or 700 tons of pulp going to the first settler for dehydration. The belt in this settler discharges pulp having 27% moisture. Therefore, from this first dehydration there would be 100 tons of slime and 37 tons of water, or 137 tons of pulp going to agitators.

Up to this point 700 − 137 = 563 tons of water has been returned to the batteries. The 137 tons of pulp going to the agitators is made up to a consistency of 25% solids by adding 300 − 37 = 263 tons of strong solution. Thus 263 tons of strong solution, plus



Slime plant at the Queen mine, British Columbia.

137 tons of pulp, or 400 tons of cyanide pulp, eventually go to the first separator. From this first separator is discharged 100 tons of slime and 37 tons of gold-cyanide solution, making 137 tons delivered from this separator.

Up to this point, 400 − 137 = 263 tons of strong solution of a value, say, of 3 dwt. per ton, containing altogether 789 dwt., has been recovered and passed through zinc-boxes, and thence to the strong-cyanide vat. The discharge from this first separator, namely, 100 tons slime and 37 tons of gold-cyanide solution, containing 3 dwt. per ton equal to 111 dwt., is washed off the belt with barren precipitated solution, producing a ratio of solution to solids of 6 : 1. The amount of barren solution added then is 600 − 37 = 563 tons of weak solution, producing eventually 600 containing 111 dwt. gold, equal to 0·185 dwt. per ton.

We thus have 700 tons of pulp with weak solution going to the second separator. From this separator the discharge is again 100 tons slime and 37 tons of weak solution at 0·185 dwt. per ton. Thus 6·85 dwt. gold is going to waste.

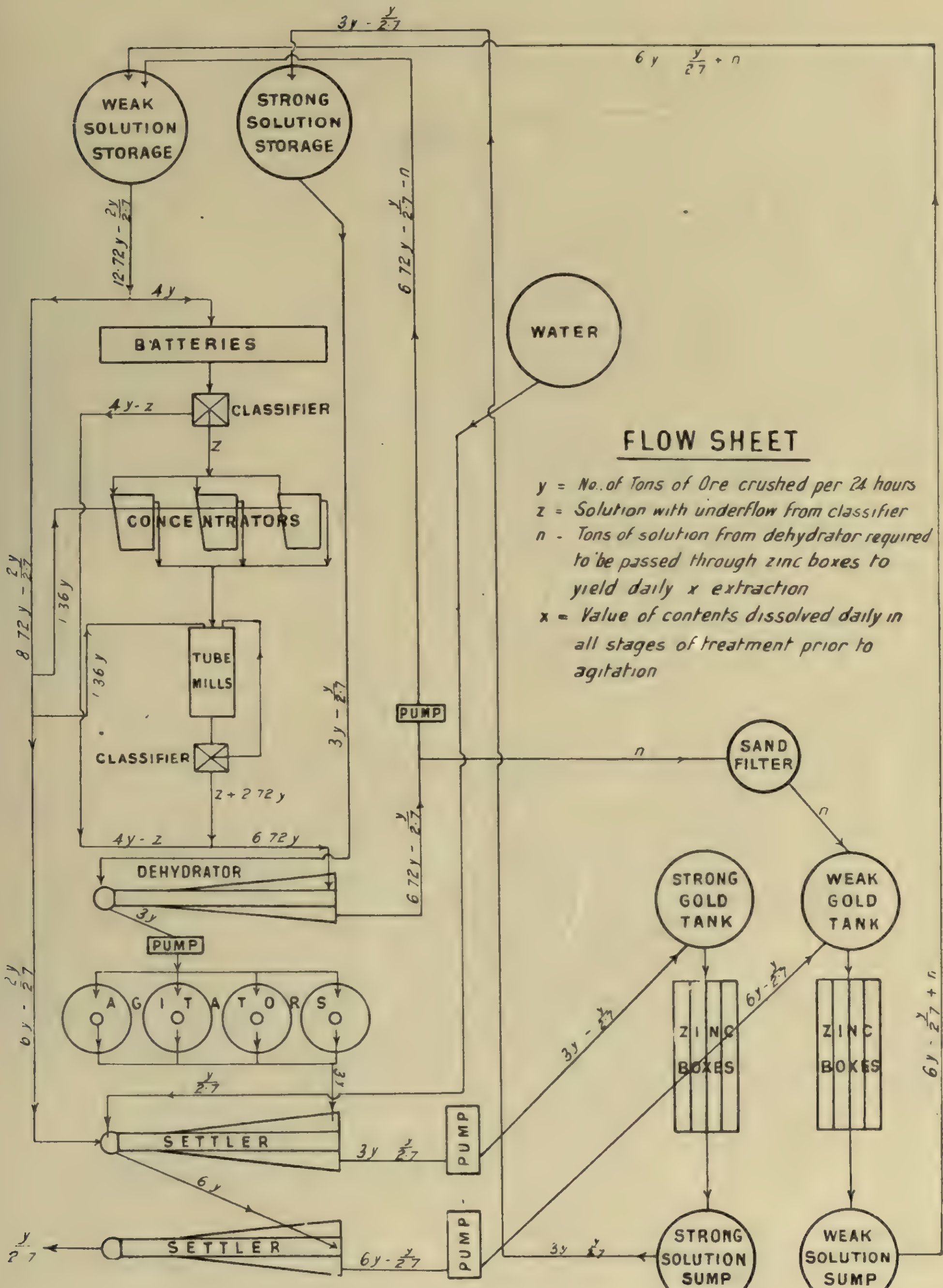
Up to this point, 700 − 137 = 563 tons of weak solution of a value of 0·185 dwt. per ton, or a total of 104·15 dwt., has been recovered and returned to the weak zinc-boxes and thence to the weak-cyanide storage-vat. Assuming now that the original ore was of a value of 10 dwt. per ton, and that 90% extraction was obtained from the solid slime, the total loss from 100 tons is 100 dwt. not extracted, plus 6·85 dwt. not dissolved, or 106·85 dwt., which gives a total loss of 10·69%, or a total extraction of 89·31%. Of the 900 dwt. gold in solution we have then a total loss of 6·85 dwt. or about ¾ per cent.

It will be seen that there is no accumulation of solution.

Simplified Spelling. — The Simplified Spelling Board, of New York, has widely disseminated a circular among men of science and learning, asking for their support in the propagation of their so-called simplified and reasonable spelling. Out of the 750 words contained in the circular, a few, that is, eight, have been chosen apparently at random as victims of the new suggestions. These are 'signd,' 'activ,' 'considerd,' 'practis,' 'negativ,' 'biografical,' 'addrest,' 'askt.' But why the 'g' in 'signd?' The circular contains a touching plea for little learners. The Nu Spelin is not making the progress anticipated.

The Progress of Rhodesia.—On October 29 the British South Africa Company celebrated its 20th birthday, for it was on that date in 1889 that the late Queen Victoria signed the Charter of the company. Though the country has not come forward so rapidly as a mineral producer or as a farming land as some had hoped, yet when it is remembered that until the pioneer column entered Mashonaland in 1890, the whole of what is now known as Southern Rhodesia was under the barbaric sway of Lobengula, it must be admitted that a substantial transformation has been made. For instance, the number of miles of railway in operation ten years after the Charter was signed was 252. At the end of the second decade this figure has advanced to 1494 miles, not counting the 506 miles in the Bechuanaland Protectorate and Cape Colony, constructed by the Rhodesia Railways. By the end of this year an additional 130 miles will be opened to the Congo border, making a total of over 1600 miles in Rhodesia. The total value of gold produced up to 1898 was £83,052; ten years after the value had risen to £11,831,525, and Southern Rhodesia is now seventh on the list of the world's gold-producers. The value of goods imported into Rhodesia during 1898 was £545,000; during 1908 it amounted to £1,678,000. It is also worthy of note that from 1895 to 1908, out of a total value of imports of £15,000,000, only £9,000,000 represented purchases from the British Empire. According to the last census, taken in September 1907, the European population of Southern Rhodesia numbered 14,007, and since that date the annual rate of increase has been much larger than in former years, and the population today probably exceeds 16,000.

Machinery for Mexico.—Owing to the expiration of the Federal regulation providing for draw-backs of duties paid on mining machinery imported for new mining or metallurgical plants, it becomes necessary to adopt the usual course pursued in obtaining special concessions. While the trouble and expense incidental to this method of obtaining a refund is hardly warranted by the amount of duty involved in connection with small plants, it is worth while to secure the concession when a plant of large capacity is to be built. A concession is obtained by making personal application to the Department of Fomento, backed by good reasons and arguments based upon the value of the new enterprise to the country. The special privileges granted may include a number of valuable features.



Treatment of Slime.

MEASUREMENT OF PULP AND TAILING. I

By W. J. SHARWOOD

Introductory. — In wet-crushing mills, concentrators, and hydro-metallurgical works it is often desirable to measure the water and ore handled, either the amounts contained in tanks or the quantities passing in a given time. In some mills such measurements are systematically made, but in others the amounts are merely guessed, or they are measured once and ever after assumed to remain constant. Discrepancies between "theoretical" and "actual" recovery are due to errors in sampling and assaying the material before treatment, added to the corresponding errors affecting the material after treatment, and multiplied by errors in the estimate of the tonnage treated. The last item is therefore fully as important as the others in calculating probable returns.

Commenting upon South African practice G. A. and H. S. Denny remark: "The returns from any given mine from month to month, and the averages which are used as comparisons, actually refer to tonnages which may vary as much as ten per cent."*

The measurements most frequently required are: tonnage of sand collected in tanks, tonnage of slime in suspension in vats or agitators, and flow of pulp or crushed ore —the last often involving measurements of water as well as of solid matter, or the ratio of water to solid, and of time.

Next to accepting the metric system in its entirety, it is most convenient for practical purposes to adopt as units the ton of 2000 pounds, the cubic foot, and the fluid ton of 32 cubic feet—the last being the volume occupied by 2000 lb. of water, on the assumption that a cubic foot of water weighs 62·5 lb. The fluid ton is a unit that has been tacitly assumed and used for years in connection with cyanide work, but I believe that it has not been thus specifically defined.†

As it frequently happens that certain measurements can be more conveniently made at mines in troy or metric units, a sufficient number of conversion factors are given in an annexed table.

Throughout this paper the word 'density' is applied to the density or specific gravity

*Journal of South African Association of Engineers, June 1906

† Since this paragraph was written W. A. Caldecott (Journal of Chem., Met. & Min. Soc. South Africa; Oct. 1908) has indirectly defined the fluid ton in the same way.

Conversion Table.

UNITS.	
1 Cubic foot	= 1728 cu. in.
	= 28340 c.c. (grams of water)
	= 62·5 lb. water = 7·5 U.S. gal.
	= 6·25 imp. gal.
1 Cubic inch	= 16·4 c.c. = 0·03617 lb. water
1 Litre	= 1000 c.c. = 0·0353 cu. ft.
	= 2·2046 lb. water
	= 0·2645 U.S. gal.
1 Fluid ton	= 32 cu. ft. = 2000 lb. water
	= 907 litres = 0·907 cu. metre
	= 240 U.S. gal. = 200 imp. gal.
1 Imperial gallon	= 10 lb. water = 0·005 fluid ton
1 U.S. gallon	= 8·33 lb. water = 0·1333 cu. ft.
	= 3775·5 c.c. = 5/6 imp. gal.
	= 230·4 cu. in. approx.
1 Ton	= 2000 lb. = 907 kg.
	= 29,166·6 oz. troy
1 Pound	= 453·6 gm. = 14·583 oz. troy
RATIOS INVOLVING TIME.	
1 Cu. ft. per min.	= 45 fluid tons per day
1 Cu. in. per min.	= 5/6 cu. ft. or 0·8333 cu. ft. or 6·25 U.S. gal. per day
1 Cu. ft. per sec.	= 2700 fluid tons per day
	= 40 miner's inches
1 Cu. in. per sec.	= 50 cu. ft. per day
1 U.S. gal. per min.	= 6 fluid tons per day
1 Imp. gal. per min.	= 7·2 fluid tons per day
1 Pound per sec.	= 43·2 tons per day
1 Ton per day	= 1·3889 lb. per min.
	= 0·02315 lb. per sec.
1 Fluid ton per day	= 0·1666 U.S. gal. per min.
	= 0·1389 imp. gal. per min.
	= 0·0222 cu. ft. per min.
	= 0·0148 miner's inch
1 Miner's inch	= 1·50 cu. ft. water per min.
	= 67·5 fl. tons per day
	= 0·025 cu. ft. water per sec.
1 Litre per sec.	= 95·24 fluid tons per day
1 Gram per sec.	= 190·5 lb. per day
	= 0·09524 tons per day
MISCELLANEOUS.	
1 Pound per cu. ft.	= 16 grams per litre
Specific gravity	= grams weight per cubic centimetre
	= kilograms per litre
	= tons weight per fluid ton of 32 cu. ft.
	= pounds weight per cu. ft. × 0·016
	= pounds weight per U.S. gal. × 0·12
	= pounds weight per imp. gal. × 0·1

of the dry, solid material under consideration, while 'gravity' or 'specific gravity' is applied to that of the pulp or mixture of water and solid. This arbitrary distinction is made simply to avoid confusion, which sometimes arises when the one term is applied indiscriminately.

Tonnage of Sand in Vats.—The tonnage of sand in vats filled by settling under water is best ascertained by means of boxes of stout sheet iron (conveniently made of exactly one cubic foot capacity, but in any case accurately measured), having a number of small perforations in the bottom and provided with handles. Several of these are placed in the vat at various stages of the filling, and are allowed to remain throughout the treatment. While the vat is being discharged these are carefully removed and 'struck' level; the contents are then dried and weighed, giving the pounds of dry solid per cubic foot. Several charges should be thus tested and averaged to obtain a constant value for the ore or tailing treated. It is desirable to place some of these boxes near the centre and others near the periphery

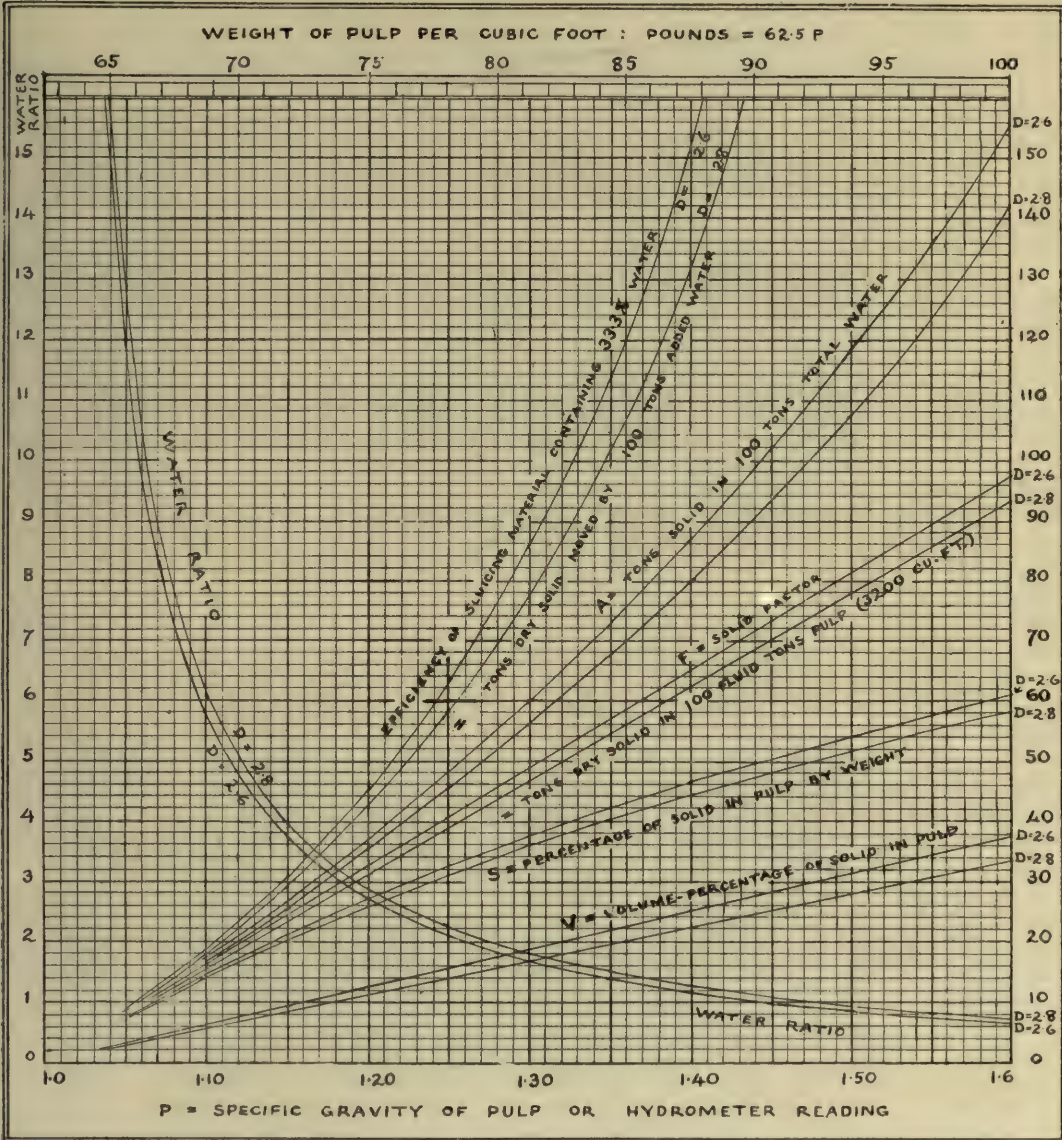


Fig. 1. Ratios of solid and liquid in pulp containing solids of density 2·6 and 2·8.

of the vat, so as to represent variations in horizontal as well as in vertical distribution. The mean weight per cubic foot and the volume of sand in the charge give the total weight of sand. While rectangular boxes are often used, a cylindrical form is preferable, as being less liable to deformation.

The Leupold sand-sampler is a short sheet-iron cylinder open at the ends, one of which is provided with a cutting edge and the other with handles.* During the discharge of a vat this is thrust into the sand, the lower end being closed by a sharpened steel plate introduced from the side. The sand thus removed is dried and weighed; then, the volume of the cylinder being known, the weight per cubic foot is determined. A round tin can, having the closed end punctured to allow the air to escape, can be used in the same way with fairly accurate results.

According to Caldecott† the tailings on the Rand have a density of 2·7, and a ton of "collected" sand occupies 21·5 cu. ft.; of "leached" sand, 24 cu. ft.; and "transferred" sand, 26 cu. ft. These correspond respectively to 93, 83·3, and 76·8 dry pounds per cubic foot.

Volume of Vats. — In estimating the cubic content of a round vat several diameters should be measured (preferably three or four making equal angles with each other at about the middle depth), and for the greatest accuracy a similar set of measurements should be made near the bottom and another near the top, the arithmetic mean of all the diameters measured being used in the computation. In supposedly cylindrical wooden vats of over 25 ft. diam. differences of 6 inches or more may be found, due to imperfect construction, to settling, or to unequal shrinkage of the staves, owing to their upper portions being intermittently dried while the lower ends remain wet.

If D be the internal diameter, and H the depth, in feet, of a cylindrical tank, the volume is 0·7854 D^2H cu. ft., 0·024544 D^2H fluid tons, 5·89 D^2H U.S. gallons, or 4·908 D^2H imperial gallons.

In measuring such a vat an error of one inch in the mean diameter makes a difference of 0·13 $D\,H$ cu. ft. in the apparent volume—causing an error of about 40 cu. ft. in a vat 40 × 8 ft., or 65 cu. ft. in one 50 × 10 feet.

*H Leupold, *Journal* of the Chemical &c. Soc., South Africa, Nov. 1904. A core-sampler, for estimating the tonnage of slime in collecting-vats, is described in the same paper.

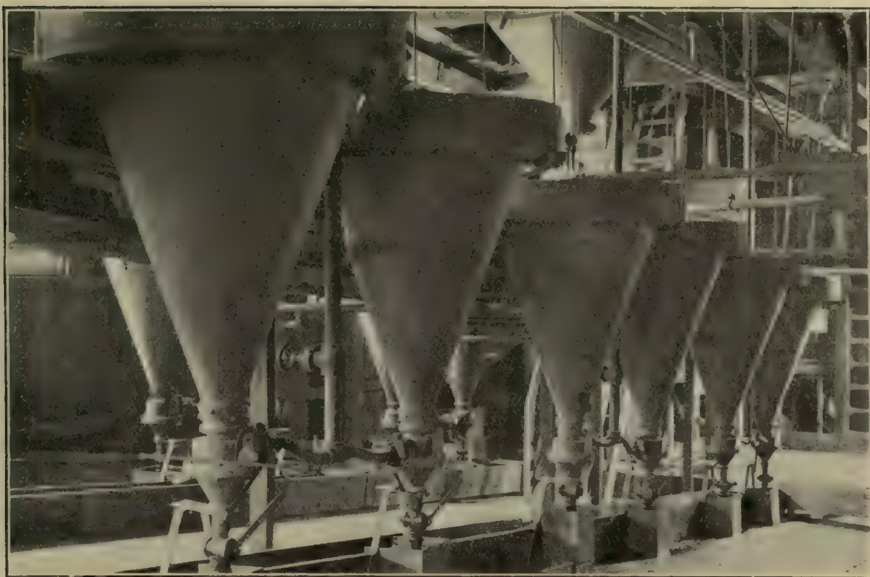
† 'Capacities of circular tanks,' *Journal* of Chem. M. & M. Soc. S. Afr., Oct. 1908.

Datum Marks. — In vats usually filled to about the same depth it is convenient to establish a permanent mark, such as a nail or cleat, at a point near the average level of the surface of the sand or solution, and to determine exactly the volume or capacity when filled to that datum. A correction is then calculated for an inch variation in depth; this can be instantly applied when the deviation of level from the datum has been measured with a rule.

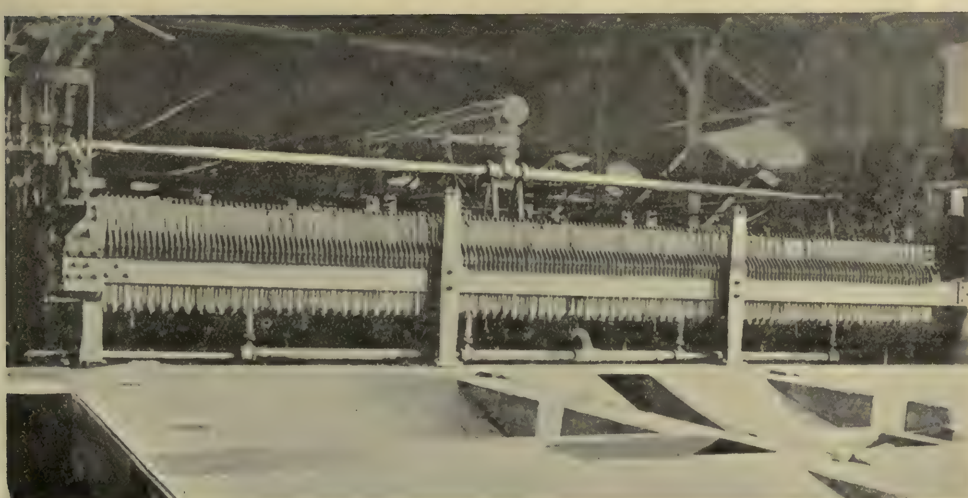
For instance, suppose a round vat with 9 ft. staves and averaging 38 ft. 9 in. diam. is commonly filled to about 8 ft. deep with sand, averaging 83·3 lb. dry per cubic foot. The bottom area is 1179·3 sq. ft., which gives 1179·3 × 83·3 ÷ 2000 = 49·12 tons sand per foot of depth, or nearly 400 tons for 8 ft. For exactly 400 tons the datum mark must be placed at a point 400 ÷ 49·12 or 8·14 ft. from the bottom. Also 49·12 ÷ 12 = 4·1 tons, or approximately 4 tons, which is the correction to be added or subtracted for every inch deviation from the mark established.

Interstitial Space. — The interstitial space in settled sand, or in slime filter-cake, is sometimes important. It varies with the mode of settling, a given sand settled under water having more voids than the same sifted dry into a vat, while either is reduced by vibration during the process of filling. Maximum interstitial space is attained when material in a moderately moist condition is introduced by shovelling or by a suitable distributor, as is well known to those who have practised the Plattner process of chlorination in vats.

If a vat filled with tailing contains n per cent. total interstitial space, then the speed of the solution percolating through it will be $\frac{100}{n}$ times the 'leaching rate' observed at the surface. For instance, if the leaching rate, or fall of surface of the solution covering the charge of tailing, is 2 inches per hour, and the interstices form 40% of the volume, then the speed of the solution descending through the charge is $\frac{100}{40} \times 2$, or 5 inches per hour. At this rate a charge of sand 8 ft. or 96 in. deep will take approximately 19 hours to drain; also, if wash-water is run upon such a charge of sand while it is saturated with solution, the strength of the effluent solution will drop rapidly after about 19 hours, provided the material is uniformly distributed.



Classifiers in the Homestake Mill.



Merrill treatment presses.

In settled sand the interstices may range from about 45 to 55%: uniformity of grain and freedom from fine material tending to give the higher value. Spheres of equal size, however, if packed as closely as possible, leave only 26% voids; if of two or more selected sizes, an even less percentage may be obtained; but such conditions do not occur in practice. Fine slime, collected in a filter-press or by settling, may show as high as 75% interstitial space when determined in a wet condition. Such high results are probably due to films of moisture held by capillarity between the surfaces of the particles.

INTERSTITIAL SPACE.

W = grams material in 100 cc. (including moisture).

= pounds per cubic foot × 1·6.

S = percentage of solid, if material is wet.

d = density of dry solid.

$$k = \frac{100\,d}{d-1}$$

IN DRY MATERIAL:

(1) Percentage of voids or interstices

$$= 100 - \frac{W}{d}$$

IN WET MATERIAL:

Percentage of actual voids or air-space =

$$(2) \quad 100 - W\left(1 - \frac{S}{100}\left(\frac{d-1}{d}\right)\right)$$

$$(3) \quad = 100 - W\left(1 - \frac{S}{k}\right)$$

Percentage of total interstices, occupied by air and water

$$(4) \quad = 100 - \frac{W\,S}{100\,d}$$

Percentage of volume occupied by water

$$(5) = \frac{W \times \text{percentage moisture}}{100} = \frac{W\,(100 - S)}{100}$$

For instance, a tailing consisting of quartz and clay has a true density of 2·5. A cubic foot of the settled material contains 80·75 lb. dry solid. The percentage of voids is therefore:

$$\text{by (1) } 100 - \frac{80·75 \times 1·6}{2·5} = 48·32\%$$

The same material, settled and partially drained, weighs 95 lb. per cu. ft. in the moist condition, in which state it is found to contain 15% moisture or 85% solid matter. It is required to find the percentage of interstices occupied by air and by water.

This is done by substituting the given values in formulas (3) and (4), the value of k for density 2·5 being given as 166·7.

$S = 85\%$ $\quad W = 95 \times 1·6$

$$\text{By (3)}, 100 - (95 \times 1·6)\left(1 - \frac{85}{166·7}\right) = 25·52\% \text{ dry air space.}$$

$$\text{By (4)}, 100 - \frac{(95 \times 1·6) \times 85}{100 \times 2·5} = 48·32\% \text{ total interstices.}$$

The difference 48·32 − 25·52 = 22·80% space occupied by water.

The last result can be arrived at directly:

$$\text{By (5)}, \frac{(95 \times 1·6) \times 15\%}{100} = 22·80\% \text{ space occupied by water.}$$

Slime Collected in Filter-Presses.—The capacity of a filter-press is most accurately determined by blowing the charge as nearly dry as possible before opening, then selecting a certain proportion of the frames at equal distances from end to end of the press, weighing the entire contents of each separately, and taking an individual moisture sample from each frame tested. The dry weight of slime in each is separately calculated and the average multiplied by the number of frames.

Another plan is to measure the total volume of water issuing from the press during filling, or to estimate it from an average of the flow from several of the outlets. The water ratio (R) of the incoming slime-pulp must be known, and also the water ratio (M) of the cake formed, where

$$M = \frac{\text{percentage water in cake}}{\text{percentage dry solid.}}$$

Then the following relation holds good:

$$\text{Tons solid retained in filter} = \frac{\text{Tons effluent water}}{R - M}$$

For instance, if a 3 : 1 sludge is pumped into a press, and 28 tons of water filter out, while the cake formed contains 40% water, whence $M = \frac{40}{60} = 0·666$; the slime filtered out weighs when dry $\frac{28}{3 - 0·666} = 12$ tons.

When the contents of the press are sluiced out, or transferred to a vat or agitator, the weight of charge may be estimated in the first case by a measurement of the flow, or in the latter by measurement of the slime-pulp after thorough mixing by agitation.

Material collected by filters of the Moore type may be estimated by either of the last three methods, or by means of a 'pilot' or test-frame of the same dimensions as those of the basket, which is treated in parallel with them and then weighed and sampled for moisture, each of the other frames being assumed to have collected an equal load.

(Part II will appear in the December issue.)

WET ASSAY OF TIN ORES

By J. J. BERINGER

THE wet assaying of tin ores is just now in an interesting stage of development, recalling that of the wet assay of copper ores twenty or thirty years ago. If my judgment as to the urgency of the problem of slime tin be correct, we ought to see a steadily increasing application of wet assaying in the control of operations upon the dressing-floors of tin mines. The chief obstacle to such development will be a mistrust in the minds of mining men either as to the efficiency of the wet methods or as to their cost. Wet methods are being used; those in control of mines are gaining experience of them, and their judgment, from which there is no appeal, will depend on results rather than arguments. Consequently, I content myself with the statement that the development will be interesting to watch; it may add to that interest if I give a sketch of the outlook as it appears to me.

In the first place I venture to predict that the sale of dressed tin ore by wet assay will be subject to the control of at least two methods agreeing in their results. This opinion probably rests on the analogy of copper ores, which may be bought and sold on the results of either the 'iodide' or the 'electrolytic' assay. Again, the ore will be finely pulverized; there will be no talk of 80-mesh sieves, except for the purpose of grading. The necessity for this fineness, just as with telluride gold ores, arises from the needs of good sampling. There are mechanical pulverizers for the assayer that will put through a sufficient quantity in ten or fifteen minutes. The more important samples will enforce the employment of such machines; and once acquired nearly all the samples will be put through them. The quantity of the tin will not be determined by weighing an oxide; this procedure will not be used even as an alternative method for purposes of confirmation. Possibly, the tin may be weighed, more or less frequently, as metal. Of the volumetric methods, two, namely, the titrations with permanganate and with bichromate of potash, are precluded because they demand solutions free from iron, and iron is everywhere. There remain the well known titrations with ferric chloride and with iodine. These should survive as mutually confirmatory operations. But the iodine method will have the wider field of usefulness because the use of ferric chloride demands assay liquors free from colour and turbidity, and the iodine does not.

Using a volumetric method for tin, the assayer should recognize, without attaching over much importance to it, a quarter of a milligramme of tin. With a half-gramme charge of ore this quantity represents about one pound of tin per ton; consequently, when pounds of tin per ton are reported, a larger charge, say two or three grammes, must be used. The assay-liquor in any case must contain the tin as stannous chloride in a fairly acid solution; such liquors must be protected from atmospheric oxygen as also from that dissolved in the water and reagents. The tin in the treated ore may be got into solution directly as stannous chloride ready for titration, or it may be got as stannic chloride from which stannous chloride may be prepared by a subsequent treatment. Other things being equal, it is obvious that the direct method is the more advantageous.

In the direct method it is necessary to reduce the cassiterite in the ore to metallic tin and to dissolve the metal in hydrochloric acid. The difficulty in reducing finely pulverized cassiterite to metallic tin does not depend on any difficulty in selecting a suitable reducing agent. Heated coal gas will do it slowly; magnesium vapour acts with almost explosive speed; and zinc vapour with an intermediate rapidity that wins my approbation. But each fails in most cases to bring the whole of the tin into a form soluble in hydrochloric acid. Even litharge heated in coal-gas can show a similarly incomplete reduction. My method is to mix the tin ore with zinc oxide, magnesia, or lime before treating with the reducing agent. This prevents fritting or fusion during the heating and yields a mass that breaks down completely when treated liberally with hydrochloric acid; with insufficient acid it yields a clot of hydrated silica, but this is easily avoided. My preference is for zinc vapour and zinc oxide, but clearly these are not essential to the process. One could mix the ore with magnesia and reduce in coal-gas, then dissolve in hydrochloric acid, and titrate with ferric chloride. This would be essentially the same method, though not as I prefer to work it. When zinc vapour is used as a reducing agent, the tin exists in the mass as an alloy with zinc and so dissolves in the acid more quickly than if it existed as small tin buttons. With dressed tin ores the solution is clear and evidently complete; but with two or three gramme charges of slime or tailing the liquor is more than a little turbid with silica and other material. This barely interferes with the ease of the titration when iodine is used, and it is hard to believe that anyone will exert himself much to remove the turbidity. It may be urged that such turbidity obscures the evidence of the complete solution of the tin and so destroys security: but there are other grounds for confidence, and resting on these I anticipate that a large proportion of the samples will be assayed by such a direct method.

There are some ores and products from the dressing-floors that are unsuitable; some of these will demand a preliminary cleaning in acid; but others may yield to an attack by chlorine, supplementing the action of the hydrochloric acid. In this case the liquor will contain stannic chloride and the method becomes what I am calling an indirect one.

The tin of the ore can be got in solution as stannic chloride by first reducing to metal and then dissolving in hydrochloric acid and chlorine as just indicated. Or it can be effected by Mr. Richard Pearce's method, in which the ore is fused with caustic soda or potash or with sodium peroxide in a nickel or iron dish, ladle, or crucible; to be followed by the solution of the fused mass in an excess of hydrochloric acid. This has the advantage of getting everything, quartz and all, into solution, and the disadvantage of being available only for rather small charges of say half a gramme or thereabouts. The preparation of stannous chloride from the stannic chloride liquors can be done by the old method of precipitating tin as a metallic sponge on zinc and then dissolving it in hydrochloric acid. But by using iron (as recommended by Mr. Pearce) or nickel (as I recommend) instead of the more active zinc, the reduction stops at the stage of stannous chloride and the liquor is ready for titration; here again the advantage lies with the more direct method. The nickel imparts a green colour to the liquor that is fatal for the ferric chloride titration, but does no harm to the determination by iodine. The longer method with formation of stannic chloride and subsequent reduction by nickel is the easier to teach to beginners; and is the one I have described in my text book on assaying. But the direct method presents no special difficulty. The changes in the instructions are as follows: The mass, cooled, after treatment with zinc vapour, is placed in an 8-oz. flask, and the crucible and cover are cleaned by immersion in 60 c.c. of hydrochloric acid. The acid is next poured all at once into the flask, which should then for safety's sake be connected with a Kipp to collect the evolved hydrogen. When the action has slackened, the acid is heated to boiling; the boiling is continued for five minutes and the acid vapours are led into a Woulffe's bottle, which serves as a condenser. The hydrogen in the Kipp is burnt. At the end of the five minutes, boiling water is poured into the flask, without removing the burner, until the bulk is about 150 c.c. A nickel coil is then introduced, just as in the longer method, and the boiling is continued for five minutes. The rest of the work—cooling in carbonic acid and titrating with iodine—remains unaltered.

That any particular ore is suitable for the direct treatment is easily determined. For example, while writing this article we tested a sample of the middle product from a Buss table. A charge of 2·24 gm. by the direct method gave a result of 14·5 lb. Two charges of 2·8 and 1·4 gm. by the longer method gave 14·6 and 14·7 lb. respectively. Another charge of 1·4 gm., cleaned with acid and then treated by the longer method gave 14·7 lb. Similar experience with a great variety of materials is the proper foundation for confidence.

Tin Deposits in the United States.—The tin deposits known to exist in the Franklin mountains, near El Paso, Texas, are to be thoroughly explored by a company formed for the purpose called the El Paso Tin Mining & Smelting Co. The capital is $700,000, of which one-half has been paid up. Operations will be commenced by sinking a shaft at a point near Mundy Springs. Hitherto prospecting and development have been confined to the sinking of shallow pits, which have shown that the mineralization extends in bands parallel to the trend of the mountains. The cassiterite occurs chiefly in quartz stringers passing through granite, but it is also found in the granite itself. Crystals of cassiterite weighing over a pound have been discovered. The minerals usually associated with tin, such as wolframite, topaz, and tourmaline, have been found, although not in quantity.

THE 1906 BOOM IN CORNWALL

By WILLIAM THOMAS

*WITH black tin at £100 per ton, crude arsenic at £25, wolfram at £150, and the trade of the country brisk, it was naturally thought in the West that the opportunity had come to improve the conditions of the mines at work and to resuscitate several of those that, for various reasons, had become idle. Nobody stopped to consider that labour was scarce and dear, that new machinery was difficult to procure because all manufacturers were full of orders, and that prices of coal, timber, and other materials had advanced considerably in price within 20 years.

The companies already operating, conscious of defective plant and questionable methods, made commendable resolutions to put their houses in order; but, unfortunately, many of them promptly proceeded to divide every available penny of profit among clamorous shareholders. Thus they were compelled to postpone improvements above ground and developments below. Levant divided over £7 per share in one year. Other mines pursued a similar policy.

Mining setts were taken up in all directions and new companies were registered in great haste. The working capital required was, in every case, seriously under - estimated. Nobody stopped to consider how £10,000, £30,000, or £60,000 could possibly drain, equip, and put in dividend condition a Cornish mining proposition, when ten times the amount is provided for an African or Australasian proposition of similar proportions. Thus, procrastination in too many of the old mines, and want of consideration in the new ventures, marked the 1906 boom in Cornwall.

After an interval comes the opportunity for reflection. Granted that in several cases results are disappointing, as yet, and that in a few instances there are no reasonable hopes of success, whatever may happen; nevertheless, amid much that is disappointing, some excellent results have been obtained. The boom enabled Dolcoath to resume the sinking of the Williams new vertical shaft, which had been suspended. The cost of this work has been chiefly met by a reserve fund, wisely accumulated out of profits. Up to the end of last June £81,000 had been expended on this new shaft and its equipment. A year or two more will see the completion of the shaft, as well as important improvements in mining and dressing. The reduction in the working cost (which was £1. 9s. 2d. per ton for the six months ending June last) will be important, for pumping, hoisting, and dressing will be affected; while improved ventilation and better facilities for handling the ore underground will cheapen operations. Reconstructed in 1799, and again in 1895, in each case without suspension of operations, and having averaged a profit of £1000 per month throughout this period of 110 years, Dolcoath now appears to be at the beginning of a new life.

South Crofty, under a scheme of reconstruction, in 1906 raised £65,000, and this sum has been expended in new plant and rapid development. For a generation the mine blundered along, year after year, mistreating 1000 to 1200 tons of complex ore per month, and never paying its way. It is now mining and crushing 5000 tons per month, at an inclusive cost of 19s. 9d. per ton, extracting tin, wolfram, arsenic, and copper, by the latest methods, and making £1000 per month profit. Recent news from the mine relates to the discovery, by cross-cutting, at the 160-fathom level, of a valuable lode, 25 ft. wide. This is the result of carefully considered exploration in a mine where, from a geological standpoint, the faulting is very obscure.

New Cook's Kitchen has lost its identity because, after a period of suspension, it passed into the hands of the late South Crofty company. Operations were resumed, in 1907, by the present South Crofty company, and as a result of recent exploration pay-ore has been found at a shallow depth. From this discovery since last January, about 30% of the tonnage crushed by the South Crofty mill has been extracted. The loss of identity here does not alter the fact that the resumption of operations is due directly to the boom.

Carn Brea, by such additions to the plant as the profits made since 1906 would permit — for no fresh capital was available — has brought down the working cost to £1. 2s. 5d.; has reasonable grounds for expecting to improve upon this in the near future; and is still making material additions and improvements

* On receiving from Mr. William Thomas a criticism of our Redruth correspondent's remarks on Cornish mining, we invited Mr. Thomas himself to give us his views.—Editor.

with a view to milling a larger tonnage.

Wheal Kitty records since 1906 closely resemble those of South Crofty. Fresh capital —though on a smaller scale—was introduced under a reconstruction scheme; new plant has been added; the periodical losses made under the old conditions have disappeared; and the dividend stage has been reached. Quite recently, when incommoded by an influx of water from the deeper portions of West Kitty, an electric pumping installation was quickly completed, and is now working with perfect satisfaction. The capacity of this pump is 500 gal. per min. under 360 ft. head. A similar policy has prevailed in some other mines, though it must be admitted that in the majority of cases full advantage was not taken of the period of high prices.

The chief lesson learnt from the experiences of the new ventures is that small amounts of capital proved altogether insufficient. Moreover, in several important cases, with an already insufficient capital, radical changes in schemes of operation were made, either with or without reason. Such changes involved a double expenditure in certain important directions and, worse than that, caused long and costly delays. The new plant required time for delivery, and meanwhile little or no progress was made in draining or other work of vital importance, although establishment charges went on. At the Dowgas Mines electric pumping was installed, failed, and was replaced by Cornish pitwork. At Wheal Busy the experience is the same. A Cornish engine is now being erected there. At Wheal Vor one electric pump gave endless trouble, and was ultimately abandoned for another, which has done excellent duty. At Botallack, after draining the Wheal Cock section of the mine 30 fathoms under adit, and making rapid progress in forking, the electric pump was removed into a badly-choked shaft on the Botallack section, and Wheal Cock was abandoned. At Wheal Jane the whole of the ball-mill plant originally erected was thrown out, and is now being replaced by Californian stamps. Such costly changes, some of them unaccountable, made inroads upon already limited cash supplies, and introduced delays that crippled all resources.

With a few exceptions, the experience in forking Cornish mines since 1906 has been costly and unsatisfactory, both with electrical and with Cornish pumps. It is manifest folly to undertake the draining of deep and extensive mine workings by either of these means unless it be clearly established that the shaft is roomy and free from chokage. At Phœnix a new vertical shaft has been sunk about 600 ft., and it is proposed shortly to tap the water in the old mine from cross-cuts from this shaft, the first to be at a depth of 700 ft. A new shaft is not always a necessity, for in some Cornish setts old shafts in good condition already exist. In such a case it is advisable to cross-cut part way and hole by diamond-drill. I am more than ever convinced of the practicability and economy of this method, as compared to the slow, costly, and ineffective attempts to utilize old, crooked, and choked shafts.

The resuscitation of old mines has been condemned because "they have been worked out." But many of them have *not* been worked out. The chances of success, in re-opening an old mine, depend largely upon the circumstances that led to the suspension of former operations. Given a tin mine closed in, say, 1895, when black tin had averaged £40 or £50 per ton for 5 years, and a second mine closed at another date, following upon a 5 years' average of £70 or £80 per ton, the chances of success in the first instance, and of failure in the second, are pretty sure, if both mines were re-started now.

Directors have been too much given to hasten matters; too keen on starting crushing; too careless about development. But this need not be specially said of directors of Cornish mines. It is equally applicable elsewhere.

The open-minded observer may collect substantial evidence of good results of the 1906 boom if he compares the average working conditions of Cornish mines five years ago with those of the present time. A telling example of co-operation in generating power is seen in the arrangements made with the Camborne Electricity Works by both Dolcoath and South Crofty. In individual mines there are numerous good examples of new central generating plants with electrical transmission. We see also the gradual replacement of the old Cornish stamps by Californian and Holman's air-cushion; the more intelligent treatment of ores, especially of mixed ores; the re-arrangement, on modern lines, of methods applied to calcined ores; the increased recovery from slime; the better types of engines and appliances for winding, pumping, and air-compression.

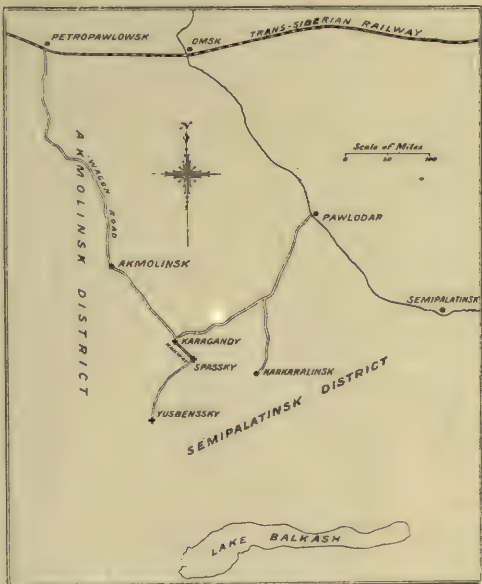
Foreign Companies are not permitted to own property within 60 miles of the Pacific coast of Siberia. This prohibition may prove embarrassing to British enterprise.

COMPANY REPORTS

Hainault Gold Mine.—This is one of the smaller mines at Kalgoorlie and is owned in Glasgow. The company was formed in 1895, milling operations commenced in 1901, and the first dividend was paid in 1905. The mine is notable because the extraction plant is different from that usually employed in the district, the Cobbe-Middleton amalgamating pans having been adopted. In the report for the year ended May 31, 1909, it is recorded that 66,737 tons of ore yielded 17,975 oz. fine gold valued at £76,355, an extraction of £1. 2s. 10½d. per ton. The total working cost at the mine was £51,546, or 14s. 7¾d. per ton. After writing off £14,641 for mine development and £6474 for depreciation, a balance of £616 is left. The recovery per ton was smaller during the year than ever before, and compares with £1. 4s. 4d. and £1. 8s. 7d. during the two preceding years. The dividends paid by the company so far have been 10% in 1904–5, 15% in 1905-6, and 10% in 1906–7. The capital was originally £70,000, and has been gradually increased to £150,000. The ore reserves are difficult to estimate, but in round figures are given at 100,000 tons, having a gross value of 29s. per ton. Since the beginning of 1909, the roaster for dealing with the concentrate has been started and the treatment of the slime by cyanide has been recommenced. In all probability the extraction will be improved during the coming year.

Caucasus Copper.—This company was formed nine years ago to acquire low-grade but extensive copper deposits at Dzansul, in the Russian Caucasus. The capital has been provided by a number of substantial mercantile houses in London, notably J. S Morgan & Co., the English branch of J. P. Morgan & Co., of New York. The concentration and smelting problems have been extremely difficult, and some of the best talent in England and America has been requisitioned in vain. At first it was thought possible to smelt the ore without concentration, and large sums of money were spent in the attempt. After that, efforts were made to concentrate magnetically, with equally unsatisfactory results. More recently, by the advice of one of the directors, James Colquhoun, late manager of the Arizona Copper Co., another effort has been made to concentrate on tables. The ore is friable and a large proportion of slime is formed, so that the recovery is low. The exact figures of extraction are not given, but a sentence in Mr. Colquhoun's report gives some indication of the situation: "Counting on no more than 50% extraction, which of course will be exceeded, the property can be brought into a highly profitable condition." Tables to treat 250 tons per day are already at work, and additional tables now under construction will shortly bring the amount treated to 500 tons per day. Close study is being made of methods of dealing with the tailing and slime. After many initial difficulties the reverberatory furnace began to run successfully in September, and the output is now about 110 tons of copper per month. J. F. Allan resigned the position of general manager in April and Mr. Colquhoun has had charge of operations since that time. According to the report for the year ended May 31 (Russian style) just issued, it is seen that the indebtedness of the company has been increased by £293,100 during the year. Of this amount £191,540 has been spent on new plant and in acquiring adjoining properties, while of the remainder £66,690 represents the loss on the working account. The liabilities of the company amount to £1,511,727, of which £500,000 is in ordinary shares, £503,100 in debentures, £452,900 in loans, and other creditors £55,727. The directors are hopeful of ultimate success, and taking into consideration the recent improvements in the treatment of low-grade copper ores they have every reason to be optimistic.

Spassky Copper.—This company was formed in 1904 to acquire the Yuspenssky mines in the Akmolinsk province of Siberia; these mines had been worked by local owners for many years; the property also included a smelter at Spassky, and coal properties, the chief of which is the Karagandy. The orebodies are unusually rich and have been proved to be extensive. On the hanging wall the ore is practically pure chalcocite, then comes bornite also nearly pure; afterward a silicious gangue gradually reduces the copper content. No definite foot-wall exists, and cross-cuts are required to ascertain the economic limit of the deposit. When the company was first



A part of Siberia.

floated, the market accepted it in booming mood and the shares went to a high premium. Certainly the nature of the ore deposit warranted the enthusiasm of shareholders, who had also every advantage in the way of reliable reports by Pellew-Harvey & Fell and by E. T. McCarthy. There were however some disadvantages, which have so far outweighed the advantages, and have compelled the company to raise further capital instead of paying dividends. In the report for the year ended September 30, 1908, just published, the directors give a statement of the present position of the company, and at the meeting of shareholders held in October the future policy was discussed. The various adverse circumstances may be enumerated: (1) The absence of transport and communication with the rest of the world; (2) the difficulty of collecting and organizing labour; (3) the interference with transport and surface work by the long snowy winters, and the consequent difficulty of collecting regular supplies at the smelter. These, however, are difficulties normal to mining in distant regions, and could not be considered sufficient to account for the delay in getting the Spassky into successful operation. The directors accordingly decided to make a change in the staff, and appointed H. C. Woolmer general manager in June 1908. At the same time F. C. Knight was made smelter manager, R. M. Percy superintendent at the Karagandy coal mine, and C. Farmer manager at the Yuspenssky mine. It was decided that far too much permanent work had been done on the surface at all three stations, and it became necessary to send back a great number of employees to their homes. Development on a large scale was stopped at Karagandy, and extra efforts were made to get the company's railway between the coal mine and smelter into such efficient order that plentiful supplies could be stored at each point and thus make it unnecessary to operate the railway during the winter season. One of the great hindrances to successful operation hitherto has been the constant exhaustion of supplies. For instance, there might be plenty of fuel at the smelter but the supply of ore ran short. To revert to the report: we find that during the year ended September 30, 1908, the amount of copper produced was 1322 tons, which realized £102,697. Of this amount 430 tons was produced during the first six months and 892 during the second half. Mr. McCarthy, in his speech to the shareholders, stated that the reorganization was progressing satisfactorily and that costs were being cut down in many directions. For the present the production of copper would not be greater than 200 tons per month and only one furnace would be in use. At the early part of next year another furnace would be blown in and the output accordingly increased. Mr. McCarthy also gave shareholders some information about the nature of the deposit and the method of mining that is advisable, explaining to them that this was a case where the demand for data about 'ore reserves' and the development of the mine years ahead of the capacity of the smelter would only embarrass the engineers. With a hanging wall of this kind, which always requires careful watching, there is every reason for restricting forward development. The present position of the company as regards finance is that there is a share capital of £300,000, a debenture issue of £212,650, and loans £50,000. The Consolidated Gold Fields of South Africa and L. Ehrlich & Co. have kept the company together during the crisis by supplying money on loan. It seems now that the company is at the end of its capital requirements, owing to the drastic reduction in expenses and the increase in production.

Mexico Mines of El Oro.—The report of this company for the year ended June 30 shows an increase in the efficiency of the plant and a decrease in the costs. The company is an offshoot of the El Oro and is under the control of the Exploration Company. The management is in the same hands as the El Oro, A. F. Main being general manager and R. M. Raymond local director. Fergus Allan is mine superintendent. The mine is situated immediately north of the Esperanza, which in its turn is north of the El Oro. During the year under review, 101,105 tons of ore were crushed and treated by cyanide, yielding $905,062 in gold and $352,496 in silver, or a total of $1,257,558. The percentage of extraction was 94% of the gold and 87% of the silver. In addition to this, 500 tons of rich sulphide containing metal worth $112,294 was sold to the smelter and gave a net return of $91,706. The total mining costs, including development, were $573,450, or at the rate of $5·67 per ton, which compares favourably with the figures for the previous year, which were $6·33. The ore reserves on June 30 were 191,655 tons, assaying $10·90 in gold and 7 oz. of silver. Development work is vigorous. The most interesting discovery was on the 7th or bottom level, where a vein of sulphide ore was struck 500 ft. from the shaft, 15 ft. wide, and assaying 2½ oz. gold and 20 oz. silver. This orebody is part of a northern extension of the West vein in the adjoining Esperanza. The total receipts during the year from the sale of bullion and ore, interest, &c., were £280,815 and the costs at the mine and in London were £125,649, leaving a gross profit of £155,166. Out of this, dividends amounting to £112,500 have been paid, £25,000 written off cost of plant, and £8300 provided for income tax. The company was formed at the end of 1904 and commenced to pay dividends just a year ago, when £45,000 was distributed. The paid-up capital of the company is only £180,000, and the dividends already distributed total £157,500. The present quotation of the £1 share is over £6. This is one of the most creditable of English mining ventures.

Camp Bird.—The report for the year ended April 30, 1909, makes a cheerful showing. The production was 80,157 tons of ore, yielding £466,030 or £5. 16s. 3d. per ton, from which a profit of £320,276 or £3. 16s. 11d. per ton was obtained. The profit is the largest in the history of the mine and permitted the payment of 20% on the issued capital of 820,000 shares of £1 each, with a balance of £190,284 carried forward. In the seven years of its history the mine has produced 476,804 tons, yielding £2,841,346, of which £1,019,583 was profit. The dividends amount to £1,107,000, or 135% on the issued capital. During the year 4859 ft. of development work was completed, chiefly by way of horizontal exploration, in accord with the advice given by J. E. Spurr. To carry out his recommendations to test outlying portions of the property it became necessary to acquire additional claims. This has been done. Inferentially, sinking has been discouraged on account of the unfavourable geological conditions existing in depth, as disclosed in other mines and in natural sections in the vicinity. Ore reserves are estimated as 121,059 tons; representing a net profit of £472,274. Of this tonnage 65,828 is ore broken and lying in the stopes. A detailed synopsis of the estimated ore reserves is given, signed by Fred. J. Pope, assistant to John Hays Hammond, who is the consulting engineer. The general manager, William J. Cox, furnishes a detailed report, from which we learn that the working cost was $9·63 per ton, to which is added $1·20 per ton for development. The diamond-drill was employed in prospecting, 1117 ft. of bore-hole being completed, but no noteworthy results ensued. Some rich ore was found on the fourth level, but work on the sixth level was suspended, in accord with Mr. Spurr's advice. The most important discovery was that of a parallel vein above the Chicago level, in the uppermost portion of the mine; this yielded ore of double the average grade and gives promise of further productiveness. The mill gave an extraction of 94·08% or 0·24% better than the previous year. Of the total yield 75% is by amalgamation, 16% by concentration, and 8·58% by cyanidation. The report gives no details of the new business in Mexico, merely stating that Mr. Hammond had advised the payment of £20,500 for a four months' option on the Santa Gertrudis mine, at Pachuca.

Dharwar Reefs.—This company was originally formed in 1904 by John Taylor & Sons to acquire mines in the Bombay presidency, and in April 1908 it was reconstructed in order to provide further capital. The report now published covers the 14 months up to June 30. During this period 21,574 tons of ore

Burning of the Camp Bird mill in 1906, after the snowslide.

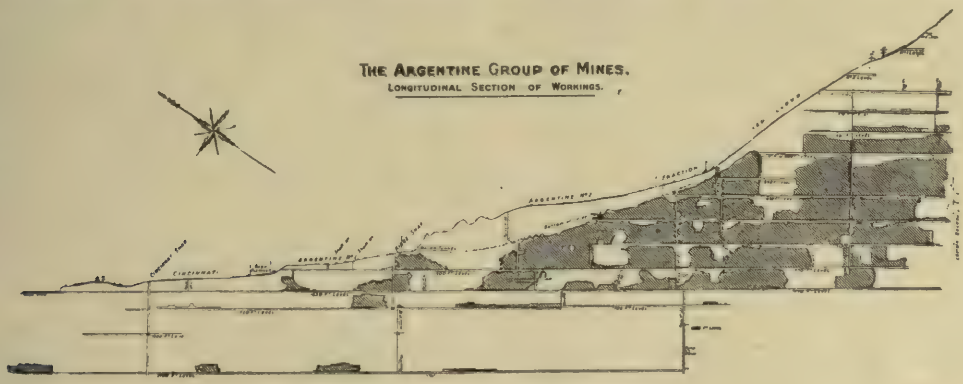
were milled and the yield on the plates was 7477 oz. bullion valued at £28,000. This was an extraction of 7 dwt., and the assay-contents of the tailing was 3½ dwt. After many vicissitudes the cyanide plant is now reported to be in working order. At first, the extraction was hindered by electrolytic re-precipitation. Unfortunately no details are published relating to the exact causes of the trouble, neither are we told how the difficulties were overcome nor the nature of the new plant. A record of this experience would be valuable. The report shows that while extensive mining and development work has been done, the results obtained are disappointing; in fact, the mill has not been able to run at full capacity.

Silverton Mines.—This company has been formed to acquire from M. S. Davys his various interests in mining properties near Silverton, in the Slocan district of British Columbia. Mr. Davys has been for many years a developer and lessee of mines in that province, his work under lease at the Hall mines being the best known in England. The interests transferred to this company comprise the leases of the Hewitt and Lorna Doone mines immediately adjoining the Vancouver, which latter Mr. Davys sold to the Le Roi No. 2 and is now operated by the Van Roi Co. In addition, the company acquires options on the Tiger group, and Mr. Davys' lease of the Wakefield concentrating plant, which has already been sub-let to the Van Roi company. Though little is said in the prospectus as to the nature of the ore, it is known to consist of low-grade zinc-lead sulphides carrying silver, with here and there richer patches that can be shipped direct to the smelter. Mr. Davys reports that the ore developed consists of 3000 tons of ore worth $40 per ton and 32,400 tons worth $6, the total value of the recoverable contents being $314,400. The mining, milling, and smelting costs are estimated at $159,300. There are also further quantities of probable and possible ore which provide for future operations.

Otavi Mines and Railway.—This is a German company owning the Tsumeb copper and lead mine in German South-West Africa and the railway connecting the mine with the coast at Swakopmund. The orebodies are rich and extensive, but being complex have presented difficulties in concentration and smelting. Until recently the ore was hand-picked and the richer portions thus collected were exported. More recently the non-shipping ores have been smelted locally and the copper matte and lead exported. The company was formed in 1900 and the capital is £1,000,000 in ordinary shares together with 200,000 deferred shares. The first dividend was paid for the year 1907 8, being at the rate of 9% on the ordinary shares and 4% on the deferred shares. The report for the year ended March 31 has just been issued. The profit on the mining operations was £91,235 and on the railway £122,191, after full allowance for depreciation, renewals, &c. Out of the total profit, £110,000 has been distributed as dividend on the ordinary shares and £60,000 on the deferred shares: the board receives a bonus out of profits of £13,333, and the remainder of the balance is put to reserve fund or carried forward. The amount of ore raised was 44,250 tons, as compared with 25,700 tons the year before, of which 27,000 tons averaging 17% copper, 30% lead, and 12 oz. silver were shipped. The remainder, 17,250 tons, were smelted locally, producing 3000 tons of lead containing 24 oz. silver per ton, and 3150 tons of copper matte containing 42% copper, 23% lead, and 16 oz. silver. Improved dressing plant is being erected. Hitherto the mining operations have consisted almost entirely of open workings, but it was found desirable a year ago to adopt underground mining below the first level. It is intended to introduce machine-drills. Proposals have been made by the German Colonial Office to acquire the railway by purchase, and in all probability the transfer will be made in April next year. The purchase price will be £1,100,000 and the money so received by the Otavi company will be distributed among shareholders as a return of capital.

New Modderfontein.—This mine is in the eastern portion of the Rand adjacent to the Van Ryn, Brakpan, and New Kleinfontein, and belongs to the Wernher-Beit group. Milling commenced in 1895 with 40 stamps. For the last two years the equipment has consisted of 120 stamps, and tube-mills have been gradually added. Since the end of the financial year, July 1, 1908, to June 30, 1909, the plant has been increased by the addition of 60 stamps, bringing the total equipment to 180 stamps and 5 tube-mills. For many years, though the output was large, the margin of profit was not sufficient to provide a dividend. It was only in 1907 that dividends commenced, the financial year 1906–7 seing a distribution of 8¾% on the capital of £1,200,000. For the year 1907–8 the dividend was at the rate of 12½%, and during the year under review the profits were sufficient to provide a dividend of 15%, equivalent to a distribution of £180,000. During this year 352,816 tons of ore were milled, yielding gold worth £588,141, at an expense of £348,663, the working profit being £239,478. The quantity of ore treated showed an increase over the previous year due to the rise in the stamp-duty from 7·58 tons to 8·95 tons per day, which was caused by the expansion of the tube-mill plant. The yield per ton fell from 36s. 2½d. to 33s. 4d. and the percentage of extraction advanced from 94·3 to 96·5%. The working cost was reduced from 22s. 2d. to 19s. 9d. per ton. Much more development work is being done now than formerly, the figures for 1908–9 being 17,033 ft. as compared with 11,283 ft. the year before, and during the current and coming years the amount of development will be maintained at a high figure. The average content of ore milled will be decreased because the increased equipment will treat larger quantities at a smaller cost, and less selection will be necessary. The payable ore reserves on June 30 were 1,461,079 tons in the Main Reef averaging 5·99 dwt., and 103,355 tons in the Modderfontein Reef assaying 6·62 dwt. In addition there are reserves amounting to 532,239 tons assaying less than 3·75 dwt., and the question in the future will be how much of the low-grade ore can be mixed with the other, and yet at a profit. The vexed question of the economy of handling large quantities with a low content with a large plant at a small profit as compared with the selection of better class ore and treating it with a smaller plant arises in this case, and the query "Why mine waste?" may be discussed with energy on each side. The analysis of the returns shows that 99,634 fine ounces were recovered in the stamps, 25,447 oz. by cyaniding sand, and 11,107 oz. by cyaniding slime. In addition 3523 oz. were recovered from accumulated slime.

Tomboy Gold Mines.—This company, operating the Argentine mine at Telluride, Colorado, and under the control of the Exploration Company, has issued its report for the year ended June 30. The report shows that the contents of the ore continue to decrease, a fact reflected in the declining profits. Two years ago the profit was £155,310 and a year ago £87,115, whereas for the year ended June 30 last the profits were only £59,861. The amount of ore milled was 102,844 tons, which yielded $487,486 by amalgamation and $332,970 by sale of copper and zinc concentrates. Other small items amounting to $12,112 brought the total receipts to $832,569. A year ago the figures were: 104,091 tons of ore, $657,561 obtained from the plates and $341,459 from the sale of concentrates. The amount of ore reserves at June 30 was 400,000 tons, which is practically identical with the estimate given last year. The working cost has been reduced during the year to $4·67 per ton, as compared with $5·13 a year ago. The year commenced with a balance in hand of £66,331, which, added to the profit, made a disposable balance of £125,594. Out of this sum, £60,000 has been paid as dividend. The disbursements also include an item of £598 paid to John Herron, the former manager, being 1% of the yearly profits. It will be remembered that this share of the profits is paid as a pension to Mr. Herron for his valuable services to the company, more particularly his stroke of business in securing the Argentine property for a mere song at the time when the original Tomboy mine was rapidly becoming exhausted. When subsequently his health failed owing partly to the high altitude and partly to labour troubles the shareholders voted him this pension. D. A. Herron, the present manager, is his brother.



The principal mine of the Tomboy company.

Amalgamated Zinc (De Bavay's).—This company has been formed in Victoria, Australia, for the purpose of acquiring the property of the De Bavay's Treatment Co. and for extending the operations. The De Bavay process is one of the flotation processes developed at Broken Hill; it acts by surface tension alone. Among the directors of the new company are W. L. Baillieu, F. A. Govett, and W. S. Robinson. The head office is at Melbourne, and there is a London office in Salisbury House. A. J. F. De Bavay, the inventor, is consulting engineer and metallurgist to the company. H. W. Gepp is general manager, and D. P. Mitchell, general manager for Bewick, Moreing & Co. and superintendent of the Zinc Corporation, has reported on the enterprise. The capital is £500,000 in shares of £1 each. Of these, 247,500 go to shareholders in the De Bavay's Treatment Co., 7500 are allotted to the liquidator of the latter company, and 122,500 are being offered to the public. The whole issue was underwritten and largely oversubscribed. The company acquires the old and new mills as well as a big tonnage of old and current tailing. The works and plant are situated on the property of the North Broken Hill Mining Co. The old mill treats 1800 tons per week and the new mill now in course of erection will treat from 6000 to 7000 tons per week. The first half of the new plant will be completed by the end of the year and the remainder in March or April next. The cost of the new mill will be about £100,000. The stock of dump-tailing acquired comprises 100,000 tons from the North Broken Hill mine, already paid for; 370,000 tons from the Block 10 mine, partly paid for; and 100,000 tons from the Broken Hill South mine, to be increased to 150,000 before the new mill starts operations, which will not be paid for in cash, but will be worked conjointly. Contracts have been made with the North and South companies for their output of tailing, in the case of the first for ten years, and of the second for seven years, extensible under certain conditions to ten years. The yearly amount from the North mine will be from 120,000 to 160,000 tons, and from the South 160,000 tons. Contracts have already been made for the disposal of the whole of the concentrate produced during the ten years. During the first half of 1909, the old mill treated 47,370 tons of zinc tailing, averaging 18·3% zinc, 3·7% lead, and 3·4 oz. silver, and produced 14,646 tons of zinc concentrate averaging 48·6% zinc, 6·1% lead, and 5·8 oz. silver, together with 256 tons of lead concentrate assaying 54·6% lead, 13·8% zinc, and 23·4 oz. silver. The profits were £17,427, with zinc at £21. 12s. and lead at £12. 10s. per ton. It will be seen that the separation into zinc and lead concentrates is far from perfect. Many improvements, however, have been made, especially in the treatment of the leady tailing from Block 10, and these will be incorporated in the new mill; consequently, in future the lead content in the zinc concentrate will be decreased, and in the lead concentrate the lead content will be increased while the zinc content is decreased. Complete discussion of the mixing of the various tailings to obtain the best result is out of place at this time, as we hope to discuss the subject in a technical article on the process. The cost of treating North and South tailing in the new mill is estimated at 6s. per ton; and of Block 10 tailing, 7s. per ton; the cost in the old mill varies from 6s. 10d. to 8s. 2d. The price paid for the zinc tailing ranges from 1s. 6d. to 5s. per ton, and in the case of the South tailing the cost is worked out on a conjoint plan. The prospectus treats the subject in detail, calculating the profits with varying percentages and prices of zinc. With zinc at £21 per ton the yearly profit is estimated at £110,000. Each shilling reduction in working costs will provide an additional £11,000 profit and each pound increase in the price of zinc will add £16,000.

PRÉCIS OF TECHNOLOGY

Carnotite is a rare mineral containing both uranium and vanadium, and is found in Montrose county, Colorado. In its pure state it averages 63% U_2O_3, 20% of V_2O_5, 10% of K_2O, and 5% H_2O, but it is usually intimately associated with silica. It was described mineralogically by Hillebrand and Ransome in the *American Journal of Science* in 1900, but it is not until now that its commercial exploitation has been described. An account is given by Justin H. Haynes in *Mines & Minerals* for October of the various processes tried with the object of utilizing the mineral on a commercial scale. In 1902 Poulot & Valleque erected a small plant on the Dolores river, 65 miles from the town of Dolores, in southwestern Colorado. In the method of treatment adopted at first the crushed ore was leached with dilute sulphuric acid, which extracted both uranium and vanadium and also any lime and iron in the ore. The solution was then treated with carbonate of soda, which precipitated all the metals. This precipitate was sold to German buyers for its uranium content, which ran about 16 to 18% of oxide. The disadvantage of the process was that nothing was obtained for the vanadium content. Subsequently a different process was adopted whereby the ore was roasted with salt and lixiviated with water, and the vanadium precipitated as calcium vanadate by the addition of lime. The uranium in the ore formed sodium uranate, which is insoluble in water. This compound was dissolved in sulphuric acid and re-precipitated with carbonate of soda so as to free it from iron and lime. This process was never fully tried owing to financial troubles that caused the works to be abandoned, though it would probably have proved too expensive. In 1902 the plant was re-started by other people with another process, but this venture was unsuccessful. The next attempt to treat these ores was made by the Dolores Refining Co., for which the author was superintendent. The process used was invented by Engle & Haynes. The ore is dissolved in hot carbonate of soda, which produces a solution consisting of a double carbonate of sodium and uranium and sodium vanadate, the iron and lime contents being untouched. The filtered solution is treated with caustic soda, which precipitates the uranium as sodium uranate. Subsequently the vanadium is precipitated as ferrous vanadate. The remaining solution consists of nearly pure caustic soda, which can be re-carbonated and used on the next charge of ore. A good deal of colloidal slime is formed in this process, and the ore is therefore preliminarily roasted so as to obviate this. The gases from the roaster may be used in the re-carbonation of the soda solution. It is interesting to note that at the eastern portion of the district where these ores are found the vanadium predominates and the ore practically consists of roscoelite. At the works of the Vanadium Alloys Co., at Newmire, vanadium only is saved owing to the small percentage of uranium in the ore; the process employed is that already mentioned in which the ore is roasted with salt and the sodium vanadate recovered by leaching with water.

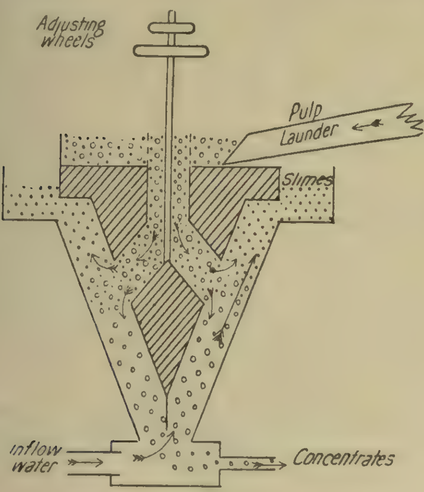
Electro-Analysis.—In the electrolytic determination of metals a frequent source of annoyance is the variation or interruption of the current. Batteries gradually lose their strength, and current from the mains sometimes temporarily fails. Consequently, some of the metal may re-dissolve or be only partly precipitated. F. O. Bacon, of Clifton, Arizona, describes in the September issue of the *Western Chemist & Metallurgist* an arrangement of the apparatus whereby the batteries are used as a reserve whenever the current from the main fails. A relay operated by the current from the main is employed. When the current from the main is on, the batteries are cut out, but directly the current fails the batteries are put into the electrolytic circuit and the analytical process is thus made continuous. When the current is restored the batteries are once more cut out. In this way a perfectly uniform current can always be obtained.

Recovering Lead Fume.—In the *Engineering & Mining Journal* for September 25, J. B Wynne describes the spray method for recovering lead fume used at the Silberhütte, Anhalt, Germany, an establishment owned by an English company that has been unsuccessful of late years. The author considered that the wetting of the fume might be effected by first mixing dry steam with the hot furnace-gases and by the precipitation of fine particles of water from the steam on cooling. Accordingly a spray of water was introduced into the flue immediately behind the furnace, where the heat of the gases was sufficient to convert the water into steam. At a distance of 25 yards a larger spray was introduced in order to cool the gases, and 50 yards farther, at a point where the temperature of the gases had fallen to 70°–90°C, a chamber was built in which sprays of water beat the fume upon rotating fans. The theory is that the steam is deposited upon the fume in the form of dew at a point during the passage along the flue where the temperature becomes lower than 100°C, and that with this preliminary wetting the fume will be more easily entrapped by the spray in the fan-chamber. In practice it was found, however, that only 50% of the fume was caught; but though the results were not good, the work was a useful contribution to the investigation of the physics of fume-wetting.

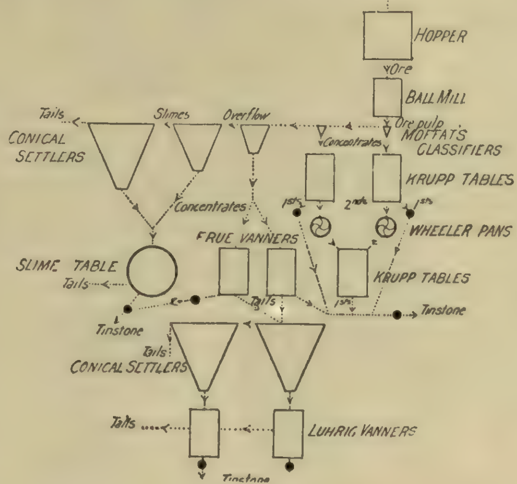
The Silver Ores of Aspen, Colorado. — J. E. Spurr, in *Economic Geology* for June, discusses the silver sulphides at Aspen, especially the occurrences in the Smuggler and Mollie Gibson mines. The author 13 years ago described this district in detail in Monograph XXXI. of the United States Geological Survey, and W. H. Weed subsequently used the information in discussing the theory of the derivation of silver sulphides from the lead-zinc sulphides by the instrumentality of descending surface waters. Mr. Spurr in the present paper goes over the same ground and gives the result of a more recent examination of one of the mines in this celebrated district.

Cyaniding in Korea.—In the *Mining & Scientific Press* for October 2 J. D. Hubbard gives an account of the method of cyaniding concentrate at the mill of the Oriental Consolidated, at Taracol. This company is owned in America; H. C. Perkins is president, and among the directors are J. B. Haggin and Ogden Mills; there is also an agency in London. The concentrate consists of 56% marcasite, 36% galena, 6% sphalerite and 2% arsenopyrite. It is not roasted, but is cyanided direct. The fine and coarse are judiciously mixed so as to ensure percolation, in 18 vats, having a capacity of 70 tons each. The charge is washed with pure water for one day, then a strong solution (2½ lb. per ton) of cyanide is allowed to percolate for 16 days; afterward there is a weak wash for 12 hours. Each charge is moved twice during the 18 days cycle of treatment by shovelling from one vat to the other. The 18 vats are divided into six series of three each, thus allowing two complete changes from one vat to another. One vat is discharged to the dump every day and one is filled. Thus 2100 tons are treated per month. Aeration is effected intermittently, two vats at a time for one hour each. The total extraction is excellent, the concentrate containing from $1·40 to $3 per ton and the tailing not more than 6 cents per ton.

Tin Concentration.—Literature on modern methods of dressing tin ores is scanty, therefore the description of the Irvinebank new plant written by Lionel C. Ball and appearing in the *Queensland Government Mining Journal* for July is welcome, though lacking in details relative to results. Until recently the reduction plant consisted of 40 stamps followed by a variety of tables. In the new mill the ore is reduced to 14-mesh in a Krupp ball-mill, which has a capacity of 50 tons per day. The product from the ball-mill is separated into sand and slime in the classifier invented by Mr. Moffat, the manager, and shown herewith. The sand is treated on Ferraris tables, from



Moffat's Classifier.



Irvine bank Mill.

which the middling is taken to be re-crushed in Wheeler pans and re-treated on another Ferraris table. The coarser slime is treated on Frue vanners, the tailing from which passes through conical settlers while the resulting concentrate is treated on Lubrig tables. The finer slime after being concentrated in conical settlers is treated on a circular buddle. The use of conical settlers is a distinctive feature of this plant. We hope that further details will be published. The chief source of ore is the Vulcan mine, which is close to the smelting works. The ore occurs in the form of a pipe from 10 to 20 ft. diam. which has already been followed down to 1200 ft.

Cooling-Towers.—Rand engineers have been interested by a paper read on 'Cooling Towers' by John Roberts, Borough Engineer of Durban, before the South African Association of Engineers. Mr. Roberts describes a new type of tower, erected by him, in which the chief features are the rectangular non-converging form, the filling of brushwood without intermediate spaces, the allowance of a clear 8 ft. below the brushwood at the bottom, the construction of doors on both sides to allow advantage being taken of prevailing winds and to check loss on the leeward side, and an ingenious system of water distribution. The water runs through holes in the cross-troughs (in which pipes of ½ in. diameter and ⅝ in. long are fixed), and drops on to small discs, 6 in. below. These cause the water to spray out in a surprising fashion and thus trickle through the brushwood more slowly and with better cooling results. A cooling tower similar in general design to that erected at Durban by Mr. Roberts was put up a year ago at the Simmer Deep; this was likewise fitted with doors regulated by pulley. Nothing has been published as to the results, so that the data received from Durban are none the less valuable. Unfortunately, Mr. Roberts did not touch upon the accumulation of scale, which is a serious factor in the operation of cooling towers on Rand power-plants.

Copper Smelting.—In the issue of the *Western Chemist & Metallurgist* for September there is a paper by the Editor collecting together the views of a number of metallurgists relating to the Catton direct smelting furnace, which is at the present time being run experimentally at West Seattle, U.S.A. This furnace contains two reverberatory hearths sloping toward a well between them. The charge in one hearth is being roasted while that in the other hearth is being smelted. When one operation is completed the hot gases are shut off and introduced at the other end, where the roasted ore is smelted and a new charge at the first end given a preliminary roast. It is thus seen that the ore is charged at alternate ends and the inlet of the gases changed so that they first act as the reducing agent on the roasted ore and then pass over the new charge at the other end where they give it a preliminary roast. The gases consist of vapourized oil and water-gas. Crude oil under pressure is introduced just above the hearth, and air and steam are forced in at the side. The vapourized oil-fuel supplies the reducing flame in smelting, and the gases resulting from the smelting operation subsequently act as an oxidizing flame at the other end. This double utilization of the gases gives rise to great economy of heat. The construction of the furnace is simple and inexpensive. It is built entirely of brick, with the exception of a few simple castings. A furnace with a capacity of 50 tons per day is 35 ft. long, 10 ft. wide, and 9 ft. high, and is estimated to cost not more than $10,000. In the article the opinions of C. H. Voll, W. E. Keith, A. Watson, and W. F. Mills are given, all of them being based on the results of their own experience in running the furnace. We give a few quotations: It was found that the recovery of the metal was never less than 95%, so that the slags were as clean as in blast-furnace or reverberatory practice. The cost of fuel is small and on the average ore smelted the consumption of crude oil was 12 gal. per ton of furnace-charge. The labour employed on a 50-ton furnace was about the same as in blast-furnace practice. As a sample of the work of the furnace, a charge averaging 2·7% copper, 2·4 oz. silver, and 0·02 oz. gold gave a matte containing 29·8% copper, 23·6 oz. silver, and 0·24 oz. gold. In another case the ore gave an analysis of 47% silica, 14% iron, 6% lime, 8·75% copper, and 15% sulphur. To this was added 3·5% limestone and 5% lime. The matte produced from this charge assayed 59·5% copper. This process resembles in some ways the Fink furnace, which was tried at Garfield, Utah. They both use for roasting the waste heat from the smelting end of the furnace, and both employ oil-fuel, but it is claimed for the Catton furnace that it can treat coarse crude ore just as well as fine and concentrate, which is all that the Fink furnace has so far treated. Also the construction of the Catton furnace is cheaper and easier. The application of the Catton furnace seems to be the simple treatment of ores at small mines and the cheap production of a matte.

Treatment of Mine Timbers. — In Vol. 45 of *Glückauf*, D. Stens describes an extensive investigation on the crushing strengths of mine props and the effect of various impregnated salts on the inflammability. The specimens all measured 15·3 in. by 2·75 in. (39 by 7 cm.) and were made of fir and pine. Various salts were tried and creosote was also tested; but all lowered the crushing strengths, this especially being the case when heating was necessary in the treatment. Though none entirely prevented inflammability all were found to be of some service in rendering it more difficult. It is interesting to note that the cheapest solution used, that of saturated brine, seemed to be the best as a fireproof material and to have least effect on the crushing strengths. The experiments were divided into three series: (1) Untreated natural specimens; (2) Steeped for 4 hours in boiling saturated brine; (3) steeped in cold saturated brine under a vacuum for 2 hours, then for 4 hours under a pressure of 4 atmospheres. The average corresponding crushing strengths were: (1) Untreated, 29,500 lb.; (2) 28,400 lb.; (3) 22,600 lb.

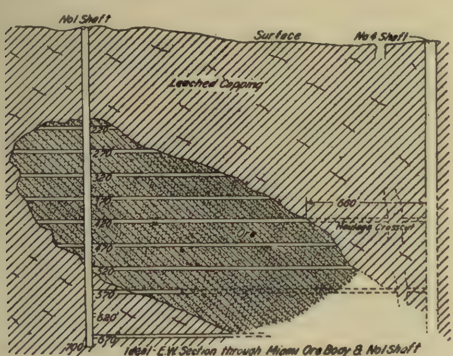
Mine Fires.—A novel type of temporary barrier in cases of mine fires is in use in Saarbrucken, in Rhenish Prussia (according to *Bergbau*) for the isolation of the affected part. The material used is compressed hay in blocks, and when the passage has been closed up with these the interstices are filled up with loose hay and the structure is then saturated with water. This causes the hay to swell greatly and by thus preventing the access of any air gives quickly and easily the first condition necessary for getting the fire under control. The material is very light and two men could easily close up any ordinary entry by its means in half an hour, using in the presence of overpowering gases and smoke a helmet to enable them to breathe while erecting the partition. If necessary a more permanant wall can be built behind the hay shield. This method has been tried and found highly successful.

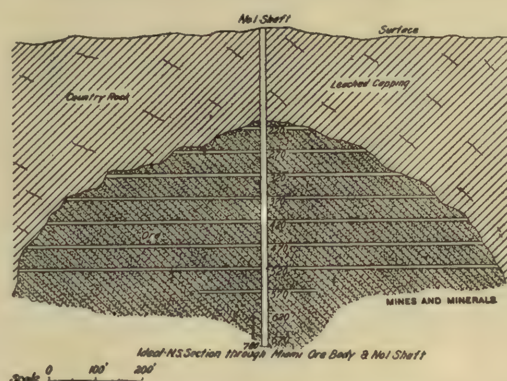
Antimonial Ores in Nova Scotia.—The method of concentrating the auriferous antimony ores found at West Gore, Nova Scotia, is described by D. F. Haley in the *Engineering & Mining Journal* for October 9. The veins are in fissures in the lower Cambrian slates; the gangue consists of crushed slate, quartz, and some calcite, and the minerals include stibnite, native antimony, pyrite, and arsenopyrite, with small amounts of sulphite and bisulphide of antimony. The native metal occurs as small stringers and bunches and is most abundant where quartz predominates. The pyrite and arsenopyrite occur as small crystals distributed through the slate within the lode. Gold is associated with practically all the constituents of the vein, both minerals and gangue. The stibnite looks pure, but contains a proportion of finely divided slate, so that it does not assay more than 45% antimony. It also contains from 1 to 3 oz. gold per ton. The dressing plant recently erected will treat 100 tons per day, and on the dump-ores containing only 4% of antimony, has effected a saving of 80% of the antimony. Hand-picking saves quite 50% of the antimony in the ore; the coarse thus recovered assays 40% antimony and 1 oz. gold. Coarse jigs produce a concentrate assaying 50% antimony and 1½ to 2 oz. gold, and fine jigs and tables produce concentrates carrying 40% antimony and 3 oz. gold. It will be seen that there is more gold in the fine than in the coarse, because the auriferous arsenopyrite is finely disseminated, and is not liberated from the gangue until the ore has been much reduced.

Distilling Zinc-Lead Ores.—John S. G. Primrose read a paper entitled 'Notes on the Production of Pure Spelter' at the meeting of the Institute of Metals in October. The novelty contained in the paper was a description of the Brand process, which is in operation at Irvine, in Scotland. By means of this process a zinc ore containing a large percentage of lead can be distilled. An ordinary zinc furnace is used, but a fume-filter is interpolated between the retort and the condenser. The filter contains a refractory material that arrests the lead fume, thus freeing the zinc from lead. The nature of the refractory material is not divulged, so it is not possible to effect a comparison with other processes of the same nature in which coke is generally used as the filtering medium. There are two 3-tier Belgian furnaces of the reversible regenerative type. Each side has five bays holding 24 retorts, which gives 240 retorts for each furnace. The retorts hold a 56 lb. charge, and measure 50 by 12 by 9 in. The trials quoted by the author did not extend over a great length of time and are not conclusive. A 3-days trial, in which 284 cwt. of Broken Hill middling was treated, is described. The middling averaged 47½% zinc and 13% lead with 18 oz. silver. This after roasting was made up into a charge with 98½ cwt. impure spelter, and 160 cwt. of residue from previous operations containing 3220 lb. of lead and 1160 lb. zinc. The zinc in the charge was 15,336 lb.; the yield was 11,020 lb., and the loss 4316 lb., the percentage of loss being 28%. The first tapping gave a 99·5% zinc and the second 99·1%. The residue contained 18% lead, 31 oz. silver, 6½% zinc, and totalled 161 cwt. It will be noticed that the loss of zinc is higher than in ordinary processes, and large amounts of lead are left behind in the residue. There is also the disadvantage that the material in the charge attacks the retorts. Further information as to the performance of the process is requisite before any judgment can be pronounced as to its practical merit.

The Miami Copper Mine, Arizona.—This is one of the most remarkable mines ever discovered and it is notable also from the fact that 13,000,000 tons of ore have been developed before stoping has been started. We therefore quote from R. L. Herrick's article on the subject in *Mines and Minerals* for

September. The mine is situated near Pinal creek, about six miles west of Globe. The ore is chalcocite finely disseminated through schist, which is much faulted and surrounded with granite intrusions, and the average copper content is 2¾%. It is two years since work on the deposit was commenced and in May of this year the preparations were made for the erection of the concentration plant. It is expected that the railway from Globe will be completed during the present month. The accompanying illustrations give an idea of the extent of the deposit and the method of mining adopted. The orebody follows the lines of lamination of the schist and its limits are defined by planes of slip. Apparently the position of the orebody was determined by the fine brecciation of the schist between several parallel slips, beyond which the ore-bearing solution did not freely percolate. The development has been done by a shaft marked No. 1, which is now 720 ft. deep. At intervals of 50 ft. in depth drifts have been extended and the ore blocked out into 50 ft. cubes down to the 520 ft. level. The pay-ore commences at a depth of 210 ft., and the first drifts were made at 220 ft. At this level the orebody is 100 ft. wide and at the 420-ft. level it measures 900 by 600 ft. In the upper levels the average copper content is over 3%. At the various levels the N.W. and S.E. drifts are stopped when the copper content is found to be less than 2½%, which is the limit of profitable exploitation. At the 570-ft. level the average is 2·65%, so that the economic limit at depth has not yet been reached. The method of mining to be adopted is the caving system, but the exact details are not yet settled. The No. 1 shaft will be abandoned and the hauling done from the new No. 4 shaft. The first haulage-level is the 420 ft.; the second is the 570 ft.; and at these levels cross-cuts have been started from the shaft to the orebody. The ore stands well of itself with little or no timbering, but its hard brittle nature and brecciated structure make it a good blasting rock. The haulage-levels will be completely timbered. No. 4 shaft is said to be the largest in the Southwest of the United States. The dimensions are 15 by 19 ft. and the timbers are 18 inches. There are six compartments, two for the skips, two for the cages, one for the ladder, and one for the pump. As regards the method of concentration, no details are as yet available, but it may be mentioned that the ore has been subjected to all sorts of experimental tests and that at a trial at the Old Dominion mill 100 tons averaging 2·8% was concentrated at a ratio of 12 : 1 with a recovery of a little less than 70%. It is stated that the engineers estimate an ultimate ratio of 16 : 1 and a recovery of 75%. In the preparation of the timber for the shafts and haulage-levels an innovation was introduced: the timber-framer went to the works of the International Creosoting & Construction Co. at Galveston, Texas, and superintended the cutting and framing of the woodwork out of Louisiana yellow pine. The timber was then creosoted, the amount used being 12 lb. per cubic foot. It was feared that the frames might become warped by the heat and pressure incident to the process, but when the timbers were delivered at the mine they were found to fit perfectly.



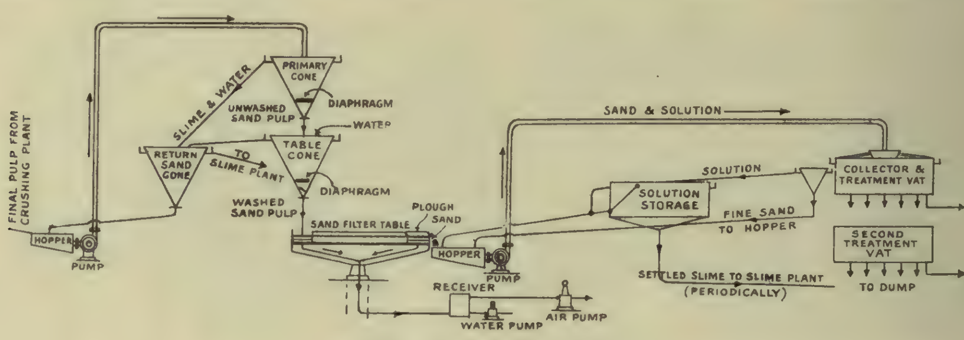


We may add that the Miami mine is controlled by the Lewisohns under the name of the General Development Co., to which J. Parke Channing is advisory engineer. The flotation was one of the most successful in recent years and was followed by a rapid rise in the value of the shares.

Electrical Equipment of Collieries.—A paper was read by W. H. Patchell before the South Wales Institute of Engineers describing the new electrical plant for supplying power to the Ferndale collieries, situated in the Little Rhondda valley, South Wales. The district is hilly and the various pits are in the valley close to the river and to the Taff Vale railway. The generating station is situated at the southern end outside the village of Tylorstown and adjoining No. 8 and No. 9 pits. The electrically driven winder is situated here. Current at 2200 volts is sent overhead to No. 6 and No. 7 pits 1000 yards up the valley, and the pits No. 1 and No. 5, No. 2 and No. 4, and two fan-pits higher up, are supplied with current at 6000 volts afterward transformed to lower voltages at the various power centres. The generating station contains three cross-compound horizontal engines, each of normal 2250 hp. and capable of carrying 30% overload. These are coupled direct to revolving-field 3-phase generators. The power is distributed to 22 haulage motors capable of consuming 3250 hp., 4 fans consuming 1060 hp., 11 pumps using 590 hp., 1 winder requiring 2000 hp., besides lighting and various surface plant. The power station is supplying electricity at the rate of nine million units per annum and the cost, including interest and depreciation, with coal at 5s. 8d. per ton, is 0·48 pence per unit. The saving in cost as compared with the old system of steam power is so remarkable that we may quote the author's own words: "The amount of coal consumed is rather less than the amount used previously to make steam for the three fan-engines, which have now been replaced by electric motors and modern fans. This means that the same amount of coal that was used to drive three fans now supplies energy to run motors aggregating 8000 hp." The winder is of the cylindrical drum type. The depth of wind is 516 yards; the output per wind, 3 tons; duration of complete wind, 53 seconds; output per day of 9 hours, 1800 tons. One remarkable point in connection with this electrification scheme is the number of foreign names among the contractors. The steam-engines and the pumps were made by Sulzer and the generators by Lahmeyer, while the winder was on the Ilgner system and supplied by Lahmeyer. The only large contracts secured by British firms were for the haulage gear by the Uskside Company, the fans by Davidson, and the winding drum by Fraser & Chalmers.

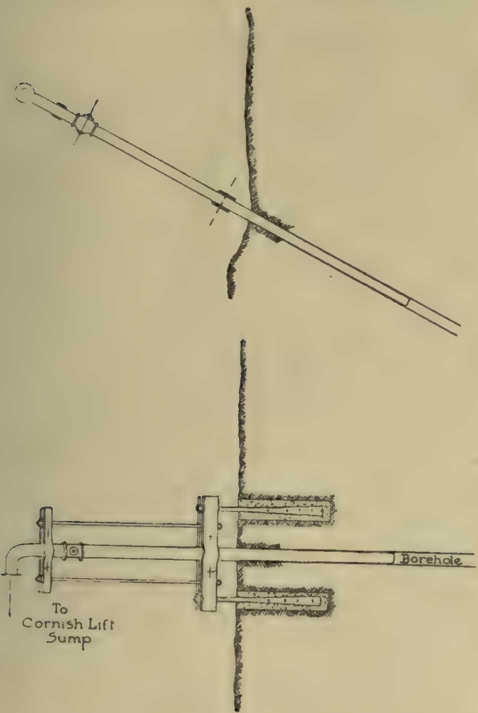
Cyanide Practice.—In the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for August, W. A. Caldecott gives a lengthy paper on the new slime-separating, sand-washing, and de-watering plant designed to prepare sand for the cyanide process as a substitute for the usual collecting-vats. The new system was evolved in the course of study of economy in cost of construction, space occupied, and time consumed in the operation of these collecting-vats. The experiments were commenced at the joint plant of the Knights Deep and Simmer East, and were continued subsequently at the Simmer & Jack. The results were so good that at the metallurgical works recently erected at the Simmer Deep - Jupiter the new system has been adopted. Mr. Caldecott's paper is a long one, giving not only a description of the plant but a history of its evolution and results of its working in comparison with the older methods. The feature of the new process is the introduction of a slowly revolving horizontal filter for de-watering the sand, after much of the water and slime have been removed by conical settlers. The first filter erected consisted of an annular launder 12 in. wide, with an external diameter of 10 ft. The bottom of the launder was formed of grating and was covered by a filter-cloth. The space under the grating was connected by radial pipes to a central hollow spindle in which a vacuum was maintained. The filter subsequently erected at Knights Deep was 15 ft. diam. with a launder 18 in. wide. The filter revolves slowly, and when the sand has arrived at a point three feet from its delivery upon the launder it is removed by means of a plough and discharged into a hopper.

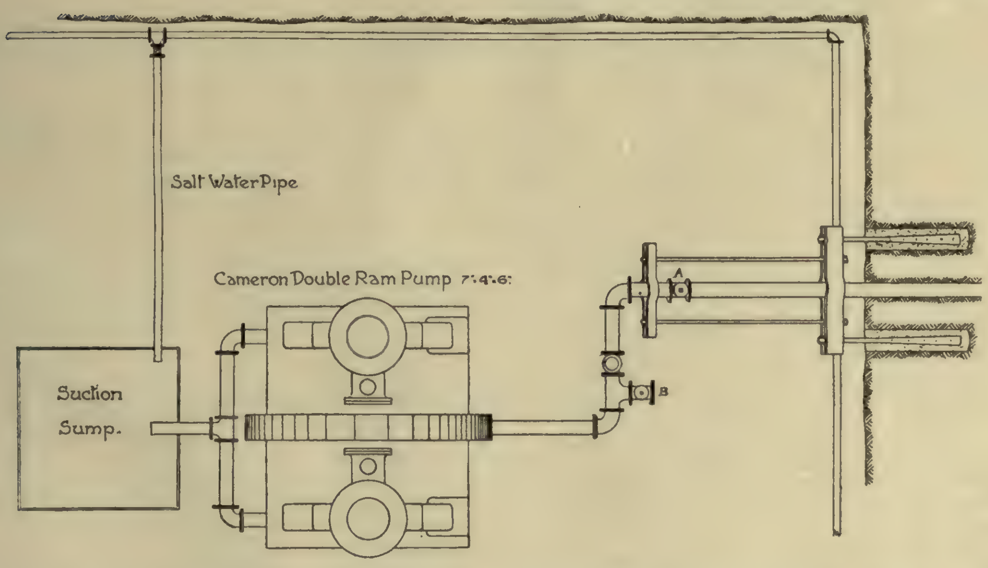
The accompanying illustration gives a sketch of the flow of the battery pulp through the cones and filter to the treatment-vat. The battery-tailing is pumped to the primary cone, where the slime is separated. The underflow goes to a secondary washing cone. The structure of these cones was described by the author in a previous paper read before the Society in March last. The washed underflow from the secondary cone as delivered upon the filter contains 30% moisture. The filtered sand is discharged by the scraper into a hopper, where it is mixed with cyanide solution while the sand and solution are pumped to the treatment-vat. The solution is kept in continuous circulation and the sand comes in contact with the cyanide immediately it leaves the filter. The use of superimposed vats under the old process was abandoned, but now that the sand is quite freed from contaminated battery-water, the author is inclined to recommend this arrangement, and uses the top vat as a collector and for first treatment. In this plant there are no trucks or transfer-belts, the recent great improvements in circulating-pumps having made it possible to transfer the pulp by means of them. In this plant the sand from the battery is brought under the action of cyanide within half an hour. The author gives an estimate for the cost of a plant to handle 5350 tons per day: 4 filters, 16 primary cones, 12 washing-cones, 12 return sand-cones, 4 sand-pumps, pumps for filters, solution-storage, sumps, and buildings, £19,019; while the 7 primary treatment-vats and secondary treatment-vats below together with the necessary structures will cost £23,156; total £42,175, or with an additional 10% for contingencies, £46,393.



Flow-sheet of improved cyanide method.

Stopping a Flow of Water from a Bore-Hole.—G. C. Klug gives an account of the method of stopping the flow of water from a bore-hole at Great Fingall, in the August number of the *Monthly Journal* of the Chamber of Mines of Western Australia. A bore-hole was driven at a point at a depth of 536 ft. from the surface, at an inclination of 27° from the horizontal. The total distance driven was 747 ft. At 500 ft. a flow of salt water was encountered producing 6000 gal. per hour. When drilling operations were concluded it was decided to take steps to control or stop the flow. A piece of steam-pipe 1½ in. diam. was tapered for half its length so that at one end the thickness of the metal was reduced to $\frac{1}{32}$ in. The tapered end was forced into the hole and the pipe held in position by means of clamps and bolts that had been cemented into the surrounding rock. The other end of the pipe was covered by a plug-cock screwed to its end. This arrangement is shown in Fig. 1. It proved effective in sealing the bore-hole itself, but large quantities of water began to come into the mine from fissures in the surrounding country. Subsequently, it was found desirable to do something to prevent the water coming in, so means were contrived for the purpose of entirely plugging the bore-hole by means of cement. A double-ram Cameron pump, having cylinders 7 in. diam., rams 4 in. diam., and stroke 6 in., was erected close to the bore-hole as in Fig. 2, and the delivery pipe was connected to the plug-cock *A*. The pump was driven by compressed air at 80 lb. pressure. A suction-sump consisting of a cyanide case was filled with water. On starting the pump the





cock *A* was opened. Pine sawdust was gradually added to the water in the sump and the water continually agitated. When about one cubic foot of sawdust had been pumped into the hole it was noticed that the leakage from the face of the rock had ceased. The pump was stopped and the sawdust removed from the sump. Clean water was pumped into the hole for a few minutes, and afterward portland cement was added to the sump so as to form a mixture of 25% cement and 75% water. This was pumped into the bore-hole in the same way as the sawdust. As the hole filled with cement the pressure against the pump increased, and after a cask of cement had entered the hole no more could be forced in. The cock *A* was then closed and the cock *B* opened, so that the pump could be thoroughly cleansed from cement. After four days the cock *A* was opened. It was found that the flow of water had been entirely stopped and there has since been no leakage through the hole or from the enclosing rock.

Cost of Mining in Chile.—At the September meeting of the American Institute of Mining Engineers, William Braden gave a short account of the conditions of labour and the cost of mining in Chile, drawn from his experience in connection with the Braden copper mines. It is usually supposed that Spanish-American workmen are inferior to those in the United States, but Mr. Braden finds that, with proper treatment and organization, labour in Chile yields as much man for man, and more dollar for dollar, than in the Western United States. The first necessity for the mine manager is to organize a staff capable by precept and practice of teaching the native the details of their work and to encourage sobriety, decency, and self-respect. The customs of the country must not be overridden rough-shod, but only altered gradually when they happen to interfere with efficiency. Comfortable quarters and other uplifting elements of life should be provided. That Mr. Braden's policy has yielded excellent results may be seen from his figures relating to costs. To understand them fully it is desirable to know something of the mine and the method of working. The deposit is a zone of fractured diorite having a hanging wall of brecciated tuff, which has a dip of 65°. The mine is quite dry, and the only timbering required is for the framing of the ore-chutes. The system of mining is one of overhead mining in a series of transverse stopes, the intervening pillars to be extracted subsequently by caving. The ore is moderately hard. Air-drills are used wherever possible, and are intelligently handled by the Chilean miners. In fact, before long hand-drilling will cease. Power for haulage and other purposes is supplied by electric current generated by Doble water-wheels. The ore is sent to the mill, 2900 yards distant and 600 yards lower, by an aerial ropeway. Mr. Braden quotes the operating report for November 1908. Upon the basis of 7304 tons extracted and milled the cost was 5s. 6d. per ton. The air-drills (2¾ in.) operated 164 man-days of 9 hours each and drilled 5082 ft. at a cost of 1d. per foot. By hand-work 13,855 ft. was drilled in 1008 man-days at a cost of 4d. per foot. More than one half of the labour was performed by contract, and in the stopes the contracts were let on the basis of the number of feet of hole drilled. Including all labour, 12 tons of ore were broken per man-day. Development was in the nature of drifts, cross-cuts, and raises, with an average section of 5·4 square yards, and the cost of labour, supplies, explosives, shovelling, and tramming was 14s. 8d. per linear foot, or 2s. 6d. per cu. yd. The amount of development was 379 linear ft., with 876¾ man-days, making 13 ft. per month per man. An example may be given: A main adit with a section of 7⅛ sq. yd. was driven 132½ ft. in 30 days; the contract price was 13s. per foot, exclusive of drill-sharpening and repairs.

Dredging for Platinum in the Ural.—In the *Mineral Industry*, Vol. XVII, L. Tovey, a Russian mining engineer, gives an account of dredging operations in the Ural, namely, the Demidoff estate in the Nijni-Tagilsk district, and the Iss river, which is tributary to the Tura. All the platinum is produced from gravel deposits, although it has been traced to its parent rock—a patch of olivine rock with chromite (dunite)—near the principal camp of the Demidoff mines. The richer portions of the deposits have been worked out by primitive stationary plants, the gravel being puddled in conical revolving screens and washed in a kind of long-tom. The output from the Demidoff estate during 1907 was about 28,750 oz., and negotiations have been begun for building a powerful dredge to work the remaining gravel. On the Iss river the alluvium consists of the detritus from different varieties of gabbro containing diallage and olivine, which crop out in large masses higher up the stream, and boulders of dunite, the source of the metal, also occur. The main deposit is worked by open-cuts and stationary washing-plants, which in 1907 recovered from 39,560 to 47,500 ounces.

Two Werf Conrad dredges, however, were in operation during 1907, recovering 3757 oz. from 260,000 cu. yd. gravel, and the loss of platinum in the tailing is reported to be insignificant. The deposit where these were in operation is of uniform character, about 17 ft. deep, and is without large boulders. The dredging season lasts from the beginning of May to early October. Farther down the river the Compagnie Industrielle de Platine, the largest producer of platinum in the world, owns claims, but besides these has many claims in the Wyia, another tributary of the Tura, and also on the Tura itself. This company has had two dredges working since 1902, but as they were bought second-hand at the sale of the Kiel canal machinery they are not very efficient, not having been specially constructed for the purpose. They each require about 11 men per shift to handle them. The overburden is about 14 ft. thick and the wash from 4½ to 6 ft. The system has been adopted of using one dredge to strip the overburden and the other to handle the wash. The stripping dredge, with buckets of 9 cu. ft. capacity, has about three times the capacity of the washing dredge, with 4½ cu. ft. buckets. A third dredge owned by the company is a small 1½ cu. ft. prospecting machine, which has a capacity of 74 cu. yd. in 10 hours. Another with 3½ cu. ft. buckets, built after the Bucyrus type, is working on the Tura. Late in the autumn of 1907 two good 5½ ft. dredges were built for work in the north of the Ural region.

Copper Mining in South Tyrol.—The process carried out at the Oss Mazzurana Copper Co.'s works is described by F. Oss Mazzurana and R. Hesse in the September issue of *Metallurgie*. The mine lies on Mount Umlât amid picturesque scenery in the centre of the dolomite region of South Tyrol, and is connected to the reduction works at Predazzo by a wire-rope railway. Ample water-power is available from the Avisio and is used for generating electricity. The ore occurs as an impregnation of copper pyrite in hard melaphyre and granite in a region of eruptive rocks, accompanied by magnetite and wolfram, and averages 1·25 to 1·50% Cu. Electro-pneumatic drills are employed, the motor-driven compressor being connected to the drill by a rubber pipe two metres long, and mounted on a separate truck. The ore is hand-picked, ground through three sets of rolls down to 7 mm., then slimed in a Krupp ball-mill. Ferraris cone-mills have been tried, but were discarded owing to the power consumed and excessive wear. A Humboldt roll-turning machine enables the rolls to be turned smooth rapidly, this being essential for maintaining an even product. The slime is concentrated by spitzkasten and round tables, the final products containing (1) 18 – 21% Cu; (2) 70% WO_3; (3) 20% WO_3 with 10% Cu, which is afterward treated electro-magnetically; (4) the principal product containing 6 to 7% Cu. The loss by this method is large, owing to the copper floating away and often amounts to 50%. Therefore the management is installing an Elmore plant. The ore is roasted in a circular furnace similar to the White-Howell, fired by a 3-jet oil-burner, the waste gases after passing through dust-chambers being used for evaporating purposes. In the centre of the furnace an iron tube projects; this is covered with asbestos and contains a thermo-couple. The roasting process is governed by the temperature, a recording apparatus registering the time for charging, etc., during the run. The ore is roasted for several hours at a temperature of 420° to 480° C, converting sulphides to sulphates, and then at 580° to 620° C the iron sulphate is decomposed completely and the $CuSO_4$ partly. $CuSO_4$ is formed by lixiviating the roasted ore with weak H_2SO_4, this being hastened by mechanical agitation; then after removing the $FeSO_4$, by adding high-grade roasted ore containing CuO and blowing air through, the solution is filter-pressed and crystallized. The final product (containing 98% $CuSO_4$, $5H_2O$) is sold to neighbouring vine-growers for spraying their plants to rid them of insects.

Cyaniding Manganiferous Silver Ores.—In the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for August, E. M. Hamilton contributes some remarks on a paper in the March issue by Robert Linton on the cyanidation of manganese silver ores in Mexico. Mr. Hamilton experimented on this class of ore a few years ago, and found that whereas the oxidized ore on the upper levels would not yield its silver to a cyanide solution, yet ore from the sulphide zone was readily treated for silver. He concluded that the silver was chemically combined with the manganese in the oxidized zone, and he devised many ways of bringing the oxidized ore back to its sulphide form.

BOOKS REVIEWED

THE MANGANESE ORE DEPOSITS OF INDIA. By L. Leigh Fermor. Four volumes, paper covers. 1250 pages. Ill. Calcutta: The Geological Survey of India.

There have been many important publications issued by the Geological Survey of India, but probably the voluminous monograph by Mr. Fermor, the assistant superintendent, will prove to be the most useful of them all, at any rate from the economic point of view. It is all the more welcome because the literature relating to manganese ores is far from complete. Perhaps the best work on the subject hitherto has been that by R. A. F. Penrose, published by the Arkansas Geological Survey in 1890. India has come forward rapidly as a producer of manganese ores during the last three or four years, and its production is on a level with that of Russia and the United States, having more than overtaken Brazil, with which it was abreast five years ago. It was only in 1891 that the first commercial operations were started by H. G. Turner, who formed the Vizianagaram Mining Co. Many prospectors and business men have gone to India since then. It is noteworthy that large amounts of manganese ore go to the United States for use in steel manufacture.

The work commences with a synopsis of the contents, occupying in itself nearly 100 pages. Then follows a general introduction giving a history and bibliography of manganese. Subsequent chapters, forming the first volume, deal scientifically with the mineralogy of manganese compounds. Part 2 is devoted to the geology, the mode of occurrence, and origin, chiefly in connection with the Indian deposits. This also is scientific in method of treatment. Part 3 gives statistical and commercial information, details of cost of working, analyses of ores, and methods of mining and quarrying adapted to the deposits; in addition there are chapters on the uses of manganese. Part 4 contains details of the various deposits found in India. The general metallurgy of manganese is not treated in much detail; in fact, the subject would be out of place in the present work. But one of these days some of our metallurgical friends ought to give us a treatise on the subject and so fill a niche at present vacant in our libraries.

THE GEOLOGY OF CAPE COLONY, an Introduction to.—By A. W. Rogers and A. L. Du Toit. Cloth, small 8vo. 500 pages. Ill. London: Longmans, Green & Co. Price 9s. For sale by *The Mining Magazine*.

This is a second edition of a work that appeared five years ago, and contains much new matter incorporating information obtained by recent examinations and investigations. The book belongs to the 'South African Science Series,' which was inaugurated to encourage the study of natural science in South Africa, and the authors are members of the Geological Survey of Cape Colony.

The ground covered consists of a description of the general geology and paleontotogy of the colony; ore deposits and economic geology do not receive much attention. From a mining point of view, Cape Colony does not present any features of great interest with the exception of the copper district in Namaqualand and the diamond pipes of Kimberley. These are not treated in this book. There are many occurrences of coal in the Karroo formation in Cape Colony, but they are of no great thickness, and most of them are spoilt for fuel purposes by the dolerite intrusions that have coked them and mixed them with ash. There are extensive deposits of iron ore in Griqualand between Prieska and Kuruman; these beds have been formed by the solution of the limestone underlying ferruginous sandstones, the fracturing of the latter, and the replacement of silica by hematite by circulating waters. The formation varies from banded ferruginous sandstone to pure hematite, and there must be enormous quantities in existence, but the distance from centres of civilization and absence of fuel make the ore practically valueless. As a contribution to the literature of the geology of South Africa, this book is valuable.

GOLD: ITS GEOLOGICAL OCCURRENCE AND GEOGRAPHICAL DISTRIBUTION.—By J. Malcolm Maclaren. Large octavo. 685 pages. Ill. Published by *The Mining Journal*, London. Price 25s. For sale by *The Mining Magazine*.

This is the latest important volume devoted to the geology and distribution of gold, and it is the best. Mr. Maclaren, by education and travel, was peculiarly well fitted to undertake the task that he has so faithfully executed. By a thorough technical education, by work as official geologist in India and in Queensland, by experience as a mining geologist in New Zealand, Western Australia, and the United States, and by professional journeys in other countries, he is well equipped to write on a subject requiring first-hand observation in regions wide apart. To this technical fitness he brings also the temperament of a scholar. This book is no scrap-book of odds and ends of information, nor is it a mere compilation of abstracts from other men's writings; on the contrary it is a harmonious presentation of a subject of scientific interest and industrial importance, prepared by an authority, himself thoroughly trained to present facts so that they enlighten and to elucidate theories so that they stimulate to further investigation. In his preface the author says that anyone writing another treatise on ore deposits "must present either new facts or a new and more scientific arrangement of already published data." Mr. Maclaren has achieved both. In order to prevent confusion the author has been careful to keep speculative inferences separate from observed facts. He does not apologize for the inconclusiveness of the speculative part of the book, for the growth of knowledge on ore deposits is as yet only a faltering guess despite the advance of economic geology during the last decade. Nevertheless the 108 pages devoted to 'The general relations of auriferous deposits' contains many generalizations and theoretical conclusions of great interest and practical value to those engaged in mining. In his introductory chapter the author outlines the accepted views on the formation of fractures, the circulation of underground waters, the filling of fissures, and secondary enrichment. This is an admirable summary. In the second part of the volume 'The geographical distribution of gold' is described in detail as ascertained by travel all over the world and by comparison with other authoritative writers. In this portion of the book the mining engineer will find information that will often be immediately useful to him as affording data concerning the character of the country rock, the relation of ore deposition to local stratigraphy, the richness of the ore already exploited, and other items bearing upon the application of geology to mining. The chapters on India, Queensland, and New Zealand are especially good. Owing to the fact that modern treatises on ore deposits, at least in English, are so largely of American publication, it is particularly satisfactory to have a book that devotes adequate space to Australasia and India, possessing important gold regions concerning which information is usually lacking in other volumes.

The book is excellently printed and beautifully illustrated. The half-tones are highly pictorial and the numerous diagrams are invaluable aids to the descriptions. Many geological maps and sections are included in the illustrations. References to other authors and observers are given generously and with minute care; in consequence, the foot-notes in themselves constitute a valuable bibliography. We congratulate Mr. Maclaren in having found time, in the course of a busy professional career, to prepare a book so scholarly, so interesting, and so useful.

T. A. R.

MEXICO.—By C. Reginald Enoch. With an introduction by Martin Hume. 8vo. 356 pages. Ill. Published by T. Fisher Unwin, London. Price 10s. 6d. For sale by *The Mining Magazine*.

This is one of the several volumes belonging to the "South American series," meaning thereby Spanish America, edited by Martin Hume. The editor contributes a short, comprehensive, and interesting summary of Mexican history. Then the reader is taken by Mr. Enoch to Vera Cruz, over the trail of Cortez, to Mexico City and across the Sierra Madre to the Pacific coast: thence to such representative cities as Guadalajara, Guanajuato, Chihuahua, Zacatecas, and Pachuca. Mr. Enoch writes in an easy and attractive manner, weaving history and observation into a harmonious narrative. He adopts Prescott's story although it is now considered by scholars as a glittering romance rather than a true history of the Spanish conquest. However, in this he is not alone, for most writers on Mexico find Prescott a stimulant to their imagination.

The chapter on 'Mineral Wealth' is neither impressive nor satisfactory. Having, apparently, no technical knowledge of mining, Mr. Enoch has compiled a scrappy jumble of facts and figures, no worse than other similar efforts on the part of writers unqualified for such a task, but distinctly out of place in a book otherwise so full of well digested information. After speaking of Lower California in unwarrantably enthusiastic terms he refers to the salt on islands "off the coast of Baja, California." A misplaced comma, of course, but why use "Lower" California on one page and "Baja" on the next, without any explanation? The names of several mining companies are spelled wrongly and the information concerning them appears to be hearsay. Other blemishes appear such as must be debited to the editor, Mr. Hume. Orizaba "towers upwards," and the Sierra Madre "rises upwards," and the temperate zone "extends upwards towards the Great Plateau." 'Upwards' is redundant and ugly in each case, and in others that are not quoted. 'Toward' is worked to death. We find an unnecessary and also an unsystematic use of italics. Why should we have *hacendado* but 'adobe,' why 'platanos' but *maguey*, or 'conquistadores' contrasted with *peones*. Nor does the sprinkling of trivial French phrases, such as *en passant* and *raison d'être*, help the style. Why is *régime* italicized? this is now adopted into English and should be written 'regime,' without the accent. The pluralizing of Sierra Madre into "Sierra Madres" is an awkward vulgarism; nor do we like "Cordilleras."

But these are little details that will irritate the reader much less than the critic. The book is what its sub-title sets forth: an account of the ancient and modern civilization of Mexico, together with a description of existing political conditions, topography, natural resources, and general development. To those who desire a trustworthy general idea of Mexico, past and present, this volume affords an attractive vehicle of information. The printing is excellent and the illustrations are superb. Several maps are provided, including a large one by Bartholomew.

The technical reader will not look for information concerning mining in a non-technical publication. He will expect general information concerning the country, its political conditions, and its history, such as he will not find in technical literature. And here he will find it, excellently served and appropriately decorated. The chapter on 'Mexican Life and Travel' is admirable, for the author has had enough experience in South America to be able to put a charming touch on the details of the peon life and to set those details in warm local colour. He gives an acute analysis of Mexican characteristics in his chapter on 'The Mexican People' and a series of vivid pictures in the chapter devoted to 'Cities and Institutions.' The early history, that of Cortez and Montezuma, is retold in spirited fashion; the revolution that ended the Spanish misrule is followed through the chaos of viceroys and bandits, up to the epoch upon which Porfirio Diaz has written his name indelibly. A fine photograph of the President is accompanied by an appreciation of his work and a hint of the dangers threatening Mexico when his firm hand is withdrawn from the Government. We commend this volume to those—and there must be many in England—desiring a general description of Mexico, her institutions, and her resources.

T. A. R.

GOLD REFINING.—By Donald Clark. Cloth, 8vo. 130 pages. Ill. Melbourne and London: *The Australian Mining Standard*; London: Sir Isaac Pitman & Sons. Price 12s. 6d. For sale by *The Mining Magazine*.

Percy and Egleston were notable contributors to the literature of the refining of gold, but since their day the cyanide process has become an important source of the metal and special methods of refining this class of bullion have been introduced; also the electrolytic processes are of recent date. Details relating to modern methods are scattered in periodicals and transactions published in England, America, South Africa, and Australia; we therefore welcome Mr. Clark's book, for it brings the subject up to date. The author is one of the best known writers in Australia, and his previous book 'Australian Mining and Metallurgy' enjoyed a wide sale.

In much of the literature relating to refining and parting the requirements for the different classes of work are not made sufficiently clear. A process might do excellently for work at a mint or in connection with the production of standard bars, but would be quite out of place at a reduction plant for improving the quality of low-grade bullion. This book treats the processes from the point of view of their uses and applications, and is much stronger in commercial than in mint processes. In fact, there is no mention of the Wohlwill process, which is used by the Norddeutsche Affinerie and at the United States mints. Among the many interesting things in the book may be noted the description of the Edwards chlorine generator used at the Australian mints in connection with the Miller process, and the author's experience with Rose's oxygen method, which he finds is unsuitable for use in reduction plants. The descriptions of various methods applicable for the refining of bullion produced at specified mines in Australia and New Zealand are of value.

E. W.

249

The Mining Magazine

Vol. I LONDON, DECEMBER, 1909 No. 4

Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

PUBLISHED BY THE MINING PUBLICATIONS LTD., at 819 SALISBURY HOUSE, LONDON, E.C.

Issued on the 15th day of each month.

Telegraphic Address: Oligoclase. Telephone: 8938 London Wall.

BRANCH OFFIÇES: SAN FRANCISCO, 667 HOWARD ST.; CHICAGO, 934 MONADNOCK BDG.; NEW YORK, 500 FIFTH AVENUE; MEXICO CITY, CINCO DE MAYO, No. 32.

AGENTS FOR THE COLONIES: GORDON & GOTCH, LONDON, MELBOURNE, ETC. (SOUTH AFRICA: CENTRAL NEWS AGENCY, LTD.)

Registered with the G.P.O. for transmission to Canada by Canadian Magazine Post.

SUBSCRIPTION RATES.

United Kingdom, 12 Shillings (Single Copies 1s.) ... ... Abroad, 16 Shillings (Single Copies 1s. 4d.)

CONTENTS.

REVIEW OF MINING

POLITICS.—At the moment of writing the strident note of political controversy fills the air, and the interest of a constitutional crisis holds the attention of the English people. And yet the national imperturbability was never better illustrated than at a period when the British Constitution is in the melting pot. Business proceeds as actively as ever, and even the shrieking Cassandras of the Press and the platform have not greatly discomposed those that deal in mining shares or direct the operations of mines. It is true there were symptoms of fear a short time ago and the Bank increased its discount rate slightly; speculation dwindled; and open accounts were reduced. This was due to the imminence of a great political crisis. When it arrived, there was a recovery. The Bank rate stands at 4½ per cent. The heavens have not fallen, trade has not collapsed, business has not ceased; on the contrary, general trade is steadily improving, no violent financial dislocation is anticipated, money is plentiful even for increasing necessities, and men turn from the last reported speech to the latest financial intelligence as cheerfully and as keenly as if we were not on the eve of the greatest political fight that this generation has seen, or is likely ever to see.

TRANSVAAL.—At the close of November the fall in representative South African shares amounted to about 25%, as compared to the highest quotations early in the summer. The water had been squeezed out and the abortive boom had collapsed. Since then there has been a slight revival. Any further liquidation will depend not so much upon speculative causes as on intrinsic factors, the chief of which is still the labour problem. The fear of labour scarcity undermines confidence and it is apparent that the assurances offered by those in control of the industry are considered unconvincing. Even in Rhodesians, notwithstanding good news from several mines in the Gwelo district and despite the impetus given by the Abercorn discoveries, there is nothing doing. At this juncture the opinions of Mr. Abe Bailey may be worth recording. According to this enterprising operator there are four reasons for the prevailing depression; shortage of labour, monetary conditions, home politics, and an over-bought market. He believes that the mines generally are doing well and that the acute stage of labour scarcity has been passed—but as to this we have reason to suppose that his hope is the parent of his belief. We discussed the matter at some length in these columns in our last issue.

Our Johannesburg correspondent refers to the tenders for the lease of the mining rights on some 2600 claims on the farm Modderfontein. Tenders were submitted for one area of about 1350 claims by a syndicate under the lead of the Consolidated Mines Selection Co. and for the other area of about 1220 claims by a syndicate headed by A. Goerz & Co., while a competitive tender for the two areas was made on behalf of Barnato Brothers. The latter are stated to have bid 7½% more of their profits than was covered by the tenders of the other houses named, although the latter, by present ownership of mines in the vicinity, are better placed to develop the ground. In order to exploit the extensive area covered by the two properties a sum of at least £2,000,000 has to be provided in order to secure something like a half-interest, for nearly 50% of the profits accruing will be payable to the Transvaal government. The assumption of such big liabilities on these terms indicates a strong and well reasoned confidence in the value of the ground for gold-mining purposes.

We refer elsewhere to the proposal for

discontinuing the publication of monthly reports by the mining companies. The storm of disapproval must have surprised those behind the reactionary suggestion, and it is not likely that we shall hear more of it. But the incident illustrates the awakened intelligence of the public, and the influence of public opinion in matters of mining finance.

RHODESIA.—The latest estimate of the ore reserves in the Globe & Phœnix shows a healthy increase in gold contents, the average being now 30 dwt. per ton as against 22 dwt. at the end of June. The total ore reserves are appraised at £1,045,151. This is cheerful. And the same can be said concerning the cablegram announcing the cutting of ore on the seventh level of the Giant Mines. As is generally known, a large orebody was being blocked out on the sixth level when the shaft collapsed, in August 1908. Since then a new shaft has been sunk at the other end of the mine and the workings from this opening have now reached the ore. Owing to faulting, and the generally disturbed condition of the ground at the seventh level, the work of exploration from the new shaft has been hindered and the intersection of the orebody has been delayed. In the interval there has been some tall gambling by persons who undertook to anticipate the news from the mine. That news comes at length in the form of cablegrams not easy to understand, simply because the ore occurrence is abnormal, the orebodies are irregular in shape and behaviour, and the usual inferences cannot be made.

The railway from Bulawayo to Broken Hill has been extended to the Congo border and on December 11 this further link in the Cape to Cairo trunk line was formally opened to traffic. The 134 miles of new railway track will connect the Chartered Company's terminus at Broken Hill with the railway system of the Congo. Credit for this important enterprise is due to Mr. Robert Williams, of the Tanganyika Concessions, whose Katanga mines will benefit from this additional avenue of transport.

WEST AFRICA.—The annual report of the Ashanti Goldfields is excellent, and it must be remembered that since the estimate of ore reserves was made, another level has been opened up. One of the features of the month has been the rise in the shares of the Wallis syndicate to £30, on the news of a discovery of banket running 12 dwt. per ton. Trustworthy information is not obtainable, but the episode illustrates the speculative temper of the public.

The postponement of milling at the Prestea Block A, owing to the delay in the completion of the Tarkwa-Prestea railway, was a disappointment, but technical opinion endorses the advice of Mr. Walter Broadbridge, on whose suggestion this policy has been adopted.

WESTERN AUSTRALIA.—Early in November a portion of the surface plant on the Great Boulder Perseverance mine at Kalgoorlie was destroyed by fire. This destruction involved the mill-engine, compressors, and Griffin mills, besides the damage to adjoining structures. All productive operations have ceased, and will remain in this condition for three or four months. The plant was insured. Development work underground proceeds as usual, so that the ore reserves will gain in the interval. We understand that the 16 Griffin mills will be replaced by 8 Krupp ball-mills.

The only other important news relating to Western Australia is the absorption of the Oroya-Brownhill and Kalgoorlie Amalgamated mines by the Golden Links, with the formation of a new company, having a capital of £312,500 in 1,250,000 shares and ownership to 259 acres of mineral land. As our readers know, the famous Oroya-Brownhill, formerly one of the great high-grade mines of the world, is nearly exhausted, and in the meantime the company owning this property has acquired interests elsewhere, notably the Leonesa mine in Nicaragua. The Oroya has a fine milling plant, which is just what the other two companies lack. They, however, have considerable reserves of low-grade ore. Thus the consolidation is mutually advantageous. It is likely to be the precursor of another, even more important, amalgamation in the same district.

CENTRAL AMERICA.—By this transfer of all its Kalgoorlie property except the accumulated tailing, the Oroya-Brownhill becomes more free to engage in fresh ventures elsewhere. As regards one of these, the Leonesa in Nicaragua, we are informed that the revolution in that Central American republic has not affected mining operations, beyond a trifling delay in the transport of supplies from the coast. The latest news from Washington indicates that the United States government intends to take strong measures to discipline Zelaya, the President of Nicaragua, against whose authority Estrada has revolted. Undoubtedly Zelaya has continually fomented trouble with his neighbours in Central America; Messrs. Taft and Knox apparently deem it high time to interfere. Thus the United States will perform that duty as policemen over the southern Spanish-American republics which is the logical result of the Monroe doctrine. It is not improbable that the Cuban experiment will be repeated, a strong native government being supported by the United States, in the interest of the country, and of Central American peace. This would be a boon to industry. Nicaragua is one of the richest mineral regions on the American continent, but development will be spasmodic and slow until good government is assured.

SOUTH AMERICA.—The past month saw the fulfilment of an engineering enterprise of great moment to South American progress. On November 27 the first railway tunnel through the Andes was finally pierced, preparatory to the laying of the rails that will unite Valparaiso and Buenos Ayres. The completion of this railway, which will be ready for passenger traffic next March, marks the beginning of a new era in the industrial development of Chile and Argentina. Until now the countries on the Atlantic and on the Pacific coasts of South America have been as strangers to each other, more effectually separated than if an ocean flowed between. This railway will be an industrial link, and it gains rather than loses in importance from the fact that it is only the first of many railways to be built through the Cordillera. Another transcontinental line through Bolivia and a Brazilian railroad to Peru are promised. All this means much to mineral exploration, and to mining as an industry.

INDIA.—Among Indian mines the Champion Reef has once more received special attention owing to the publication of the report for the year ended September 30. The general impression given by the directors and the engineer is that there are good reasons for expecting this mine to turn the corner, although sufficient work has not been done to warrant any precise estimate of the newly developed ore. The prospects are certainly much better than they were a year ago, and at several points the developments are decidedly satisfactory. The amount realized by the sale of gold during the year ended September 30, was £436,097, which is approximately £30,000 less than during the previous 12 months, but on the other hand there has been less expenditure out of income for permanent work, so that it has been possible to pay the same dividend as last year, namely £52,000, which is at the rate of 20% on the nominal capital. All the mines at Kolar have passed through barren zones, notably the Nundydroog and Ooregum, and recovered once more, and there is every reason for believing that Champion Reef will have the same experience. In other parts of India, attention has been attracted to a hopeful find at the 1140 ft. level of the Dharwar Reefs, where developments had previously been most depressing.

RUSSIA.—Further interest in Siberian mining has been stimulated by the report of the

Lena Goldfields, which is an English holding company controlling a Russian corporation called the Lenskoie. The latter operates three groups of alluvial mines in the valleys of the Lena and Vitim rivers. An ancient river-channel containing gold-bearing gravel is being exploited with remarkable success. During the past fiscal year the gold extracted has realized £1,348,000 from the washing of 604,000 cubic yards of gravel, yielding a net profit of over £400,000. This has warranted the declaration of a dividend of two shillings per share (on 1,122,216 shares), on the assured expectation of a larger dividend to be declared by the Russian operating company in May or June, 1910. The declaration of the dividend has been criticized, but it is explained by the fact that, under the articles of association of the Lenskoie, the directors are precluded from paying any dividend before the annual accounts have been audited and approved by the shareholders in general meeting, and the Russian directors have formally resolved to do so. The rest is a matter of banking arrangements. It is stated that the company's property covers 49 miles of alluvial channels available for exploitation. A report by C. M. Rolker has been issued; in this it is stated that upon the main channel in the Bodaibo valley about 2,500,000 cubic yards remain to be worked. This is one of the great gold mines of the world.

ALASKA.—From the vicinity of the Arctic Circle comes news of one of those periodic gold rushes that awaken hopes of the discovery of a second Klondike in Alaska. We mentioned the Iditarod diggings in our October issue; we learn now that over 2000 miners have 'stampeded' from Fairbanks, Nome and Dawson to this new gold district in central Alaska. The diggings are in the valley of the Iditarod, which is a tributary of the Innoko. It is a journey of 310 miles by river from the Yukon to the new goldfield, which can also be reached from the coast at Seward by a trail 450 miles long. The gold-bearing gravel is frozen, so that no water hinders shaft-sinking, and excavation is effected by thawing with steam-points or wood-fires. The alluvial channel is 600 feet wide, and bedrock is from 9 to 14 feet deep. The ground yields from 7 cents to $3 per pan. It is expected that wide-spread prospecting will ensue during the current winter aud it is hoped that a goldfield of the first rank will be developed.

CANADA.—According to official reports the discoveries near Porcupine lake in northern Ontario indicate a new goldfield of promising character. The gold occurs free in milk-white quartz. Other mining camps in the adjacent region south of the line of the Grand Trunk Pacific railway have come into existence through finds of gold-bearing quartz, and at Frederick Lake nickel ore has been identified. Rushes of prospectors have ensued, but no real development is likely before spring. Gowganda, which is a silver district, has diverted attention from Cobalt. It is stated that ore has been accumulated at several mines and is ready for shipment, but the absence of a good wagon-road, not to mention a railway, retards development. The cost of transport is prohibitive, but better conditions are assured, for the new government road from Elk Lake to Gowganda is to be opened shortly, and the Canadian Northern, which is advancing its line from Sudbury to Port Arthur, is to have a station at Gowganda Junction, which is 40 miles from the Gowganda mines. The Provincial government has undertaken to improve the navigation of the Montreal river between Latchford and Elk City, by the construction of a big dam, which is to obviate two portages. In the meantime the mine operators at Elk Lake and Gowganda are clamouring for a railroad and proclaim their intention of making heavy shipments as soon as the winter roads are passable.

COPPER.—The unanimous judgment of the United States Circuit Court for the eastern district of Missouri, delivered on November 20, pronounced the Standard Oil Company of New Jersey a combination in restraint of trade and a violator of the Sherman Anti-Trust Act. This decision disturbed the delicate negotiations then pending for the formation of a copper 'combine' and caused a violent break in the American stock-market. On the face of the Appellate Court's pronouncement, although subject to review by the Supreme Court, it was apparent that the proposed copper deal might likewise be deemed illegal. But in the United States it is a favourite pastime for lawyers to discover flaws in any Act restraining their clients from the free exercise of financial talent, and we shall be surprised if a means is not evolved for evading anti-trust legislation. Even should the Supreme Court sustain the recent judgment and compel the dissolution of the Standard Oil monopoly, that event cannot supervene for a year or two, thus affording plenty of time for the Amalgamated-Standard financiers to create their 'combine,' strengthen the copper market, boom their shares, and unload at high prices upon the patient public. At the end of the month the representatives of the proposed copper combine went to Washington, to interview the President, and to explain that their scheme was for the benefit of the country, not themselves. We can imagine that even a cynic might appreciate the force of some of their arguments. Unless some agreement is reached, a collapse is inevitable. By reference to a recent share-list of American copper mines we find that even with copper at £60 the dividends average only 5%, this fact emphasizing the lengths to which speculation has gone. It is known that fully 100,000 tons of copper metal are lying in the warehouses of England, France, and Holland, besides a considerable amount held by manufacturers on which loans have been obtained; thus the total copper stocks on which the banks have made advances must aggregate 150,000 tons, which at £50 per ton means no less than £7,500,000—a lot of money to be borrowed on a single commodity. If the leading producers fail to agree, the resulting collapse may carry copper to £40 per ton. Meanwhile, there has been some lively speculation, especially in Boston Copper, a mine in Utah.

Apparently Rio Tinto is not participating in the combine, nor Calumet & Hecla, nor Phelps, Dodge & Co., these important interests preferring to preserve an attitude of benevolent neutrality, rather than tie themselves to the Amalgamated kite. Even if the public has a short memory, the able men controlling the three independent companies just mentioned are not likely to have forgotten earlier efforts of the Amalgamated directors to subvert the laws of supply and demand by artificial restrictions. The basic fact behind all uncertainties is that the copper produced by the Amalgamated company costs three cents per pound more than the metal marketed by the new mines of Utah, Nevada, and Arizona, and four cents more than the copper sold by the Calumet & Hecla.

As we go to press the statistics of the American Copper Producers' Association are published, showing that on December 1 the stocks on hand were 153,003,527 lb., being a decrease of 506,099 lb. as compared to November, but an increase of 30,646,261 lb. as compared to January. In November the American copper production was 121,618,369 lb. as compared to 124,657,709 lb. in October, while the total output this year so far is 1,287,574,401 lb., of which exports have absorbed 621,396,050 lb. and domestic deliveries 645,532,050 lb., so that the American production is nearly equally divided between export and domestic consumption. The latest news as to the combine mentions the Cerro de Pasco mines, in Peru, as included in the deal. These are, or were, controlled by James B. Haggin and his associates, of New York.

EDITORIAL

WITH DEEP REGRET we chronicle the death, on December 5, of Hilary Bauerman, the oldest graduate of the Royal School of Mines. As dean of the mining profession in London and as an influential member of the council of the Institution, he was a well known figure at all representative gatherings. A man of wide experience and ripe knowledge, he commanded general respect, but he also won to an unusual degree the affectionate esteem of all who knew him.

ON THE OCCASION of the recent annual dinner of the students in the Royal School of Mines, it was delightful to observe the more than friendly regard expressed for the professors of mining and metallurgy. This is an excellent omen of effective instruction. We congratulate Mr. S. H. Cox and Mr. W. A. Carlyle.

WE PUBLISH another tabulated list of mining shares contributed by an anonymous correspondent, for whose good faith and unusual knowledge we vouch. When a similar article appeared in our first issue we subjected ourselves to the charge of inconsistency, seeing that our declaration of policy specifically included (1) aloofness from the stock-market and (2) the absence of intention to give tips on mining shares. As to the first, no departure has been made; as to the second, we have deviated in the interest of our readers. It has become known to us that mining engineers and metallurgists, especially those resident near a stock-exchange, whether in London or at New York, do take a keen interest in the speculation incidental to mining. As we were going to press in September we were offered an article with the query whether we dared to publish it. Our answer was that we would, if it was true and interesting to our readers. We read it, and found that it came under this necessary description and then, having ascertained the perfect good faith and competency of the contributor, we accepted the article. It proved interesting at once; it has proved true since. We publish a sequel, believing that thereby we tend to fulfil our purpose, which is to give information useful to the readers of this Magazine.

IN a consular report from Moscow it is stated that Russia has vast resources of copper, for besides the deposits in the Caucasus there exist "enormous beds of *coprolites* in central Russia and in the Dniester basin, the quantities in the latter alone being estimated as high as 27,000,000 tons." The italics are ours. This is quoted by a leading London financial publication, printed on pink paper. When metallurgists can get copper from coprolites, they will extract tin from tintinnabulations, lead from ledgers, and gold from guano.

REPORTS are usually meant to convey technical information to untechnical persons. In days gone-by the mining engineer thought it proper to swamp the struggling intelligence of shareholders by conveying his information concerning a mine in the sesquipedalian verbiage of a technological dictionary. But the method is obsolete. Nowadays the plain language of commerce is deemed proper in the business of mining and the use of unfamiliar terms is considered an eccentricity. But the growing interest in Russian mining ventures has introduced a variety of terms as confusing to the general public as the petrographical and geological nomenclature that formerly puzzled the average speculator. The weights and measures of the Russian people are strange to Englishmen, they should therefore not be used in English reports intended for domestic consumption. And the more weighty the opinion of a mining engineer and the more valued his description of a mine, the more desirable is simplicity in the use of terms. We have in mind Mr. C. M. Rolker's report on the Lena Goldfields. What with 'puds,' 'zolotniks,' 'dolis,' 'sajenes,' 'funts,' 'roubles,' 'kopecks,' etc., the reader, with the best of intentions, is easily discouraged. In English reports only the accepted units should be used, and all foreign weights and measures should be translated. Even an appendix or foot-note is less desirable than the entire disuse of unfamiliar terms. As much will be heard of Russian mining in the near future, we urge this point on engineers.

A STORY is told concerning a capitalist who was not attracted to an American mining enterprise by the statement that it involved a deposit of gravel seven feet deep averaging \$3·70 per yard, because to him it was "too small a proposition," but the same man was fascinated by the tale of a bank of gravel 100 feet high that yielded 26 cents per cubic yard. The second seemed to him to be a fine and large basis for a big undertaking. In both cases the acreage or superficial area of the deposit was not emphasized, so that an essential factor was overlooked, as might be expected. The point we dwell upon is the fact that the same relative amount of gold was contained in the seven feet as in the 100 feet of gravel, while the quantity of material to be handled was between 14 and 15 times as much in the one case as in the other. It was like the difference between 1000 tons of 10 dwt. ore and 20 tons of 25 oz. stuff. The emphasis was placed on quantity rather than quality, on cost per unit rather than on net profit over all.

THAT MONEY is available for new business and that it is forthcoming even under the shadow of constitutional crisis is shown by the number of prospectuses issued in London during November. In that month 79 prospectuses appeared, calling for capital to the amount of £21,599,700. As the *Financial Times* points out, this total has not been exceeded for the same month in any year since 1900. Of the various issues only six were devoted to mining, and the amount involved was trifling; special attention was given to new insurance offices, four companies asking for an aggregate of £1,400,000. Rubber shares are prominent in the flotations, accentuating the widespread interest aroused in that industry. Skating-rinks and motor-cabs have been the basis for several promotions. In 1908 not less than 518 capital issues were recorded, for a total of £219,735,700; so far 1909 is credited with 609 issues, involving £232,618,900. In mining a conservative tendency has been displayed, the consolidations effected among old companies being more important than the new flotations.

SOME of our friends have assumed that this Magazine is a transplanted revival of the *Mining Magazine* published in New York by W. J. Johnston from 1904 to 1906. Indeed, we have heard that it is supposed that these pages are printed in America, for subsequent distribution in England and elsewhere. We deem it proper to remove any such misunderstanding. The New York *Mining Magazine* was a useful periodical but it died for want of breath in 1906, being then merged in the *Engineering and Mining Journal*, on the initiative of Mr. John A. Hill, the enterprising publisher of several technical and trade papers. We are in no way connected with, or related to, any of these, nor do we claim descent from a much earlier *Mining Magazine*, published and edited by William J. Tenney at New York from 1853 to 1858.

On the contrary, like a useful but humble animal much used in mining exploration, we have "no pride of ancestry nor hope of posterity." *The Mining Magazine* is no renaissance or réchauffé of other efforts of a similar kind; neither is it printed in America nor controlled by our friends on the other side; it is a new venture, owned and edited by Englishmen, printed at Rugby, published in London, and meant to be an earnest effort to give the British metropolis a technical publication worthy of the mining and financial centre of the world.

OCCASIONALLY *The Times* rises to the occasion as in the days of Delane and publishes authoritative information untainted by political prejudice. Such was the recent article on the financial position, in which an able writer refers to "the chorus of Cassandras, singing our approaching doom in crashing and crushing harmony." He makes it clear that not actual conditions frighten the investor but the threats of dire disaster uttered by politicians. From time immemorial our country has been "going to the dogs," Great Britain is pronounced decadent, the business of the Empire is being snatched by competitor nations, and things generally are about to come to a bad end. Yet we have survived the jeremiads and business has continued to grow long after the Jeremiahs have ceased their vaticinations. All these depressing groans of self-constituted mourners over vanished national vigour are due to the interpretation of "simple economic causes in terms of politics." A good example is the statement that British credit is proved to be declining by the increasing investment of money abroad. A man needs to be neither a Rothschild nor a Revelstoke to puncture this fallacy, for it is obvious that the improved administration of foreign lands and the increased security to property afforded in regions formerly distressed by political instability, has tended enormously to enlarge the avenues open to the safe investment of capital. The waste places of the earth have become civilized, turbulent peoples have accepted the reign of law, and countries formerly suffering from revolutionary excesses are now as safe as the Strand. Capital is offered enlarged opportunities abroad, with high interest and diminished risk; and in the meantime the financial resources of our own people have augmented so greatly that domestic investments do not suffice and the yield therefrom has dwindled so greatly as to render them unremunerative, not because they are insecure but because they are so safe as to attract more buyers than sellers. Consols yielding 3% and English railways quoted at a price that gives only 4% per annum illustrate the fact that there is no fear for the principal of the investment, but suggest also that there is no probability of speculative enhancement. Therefore the capitalist seeks elsewhere for opportunities offering a higher return, even with a greater risk; he prefers a mine yielding 10 or 15%, although it be speculative, to a railway that yields him only 3½ to 4%, with no prospect of a rise. With £900,000,000 of deposits in the joint-stock banks drawing only 1%, is it any wonder that capital seeks an outlet abroad?

FROM time to time we note paragraphs and interviews in the daily Press and even in the Sunday papers concerning the mineral resources of Sonora and of western Mexico. A gentleman from Hermosillo relieves himself of sundry platitudinous remarks concerning the resources of Sonora and this interview is published in similar form by several papers. Apparently the information must possess unusual value to somebody, otherwise the gentleman would not have been interviewed in identical terms by more than one paper. In every case, whether it be a paragraph or a column, the reader is informed how valuable are the mines of Barranca. In *The Sunday Times* he is told, in phraseology long outworn, that "the orebodies wherever developed prove to be of unusual width and at times carry quite extraordinary values in both gold and silver, whilst in Barranca and the surrounding district the work done shows a steady increase in the value of the ore as depth is attained." It would be interesting to know what is the usual width of an orebody, and why the "extraordinary values" prevail temporarily, for they exist "at times." Also, what is an 'ordinary' value and what is the gentleman's notion of depth—is it just under the outcrop or in the zone of secondary enrichment or in the barysphere itself? As to the increasing richness in depth, that old yarn had paresis in the days of the Phoenicians. We are glad to see attention directed to the mineral resources of Sonora, but it is a pity to make them a tail to the kite of Barranca, as to which proper technical information is needed. Whether the Barranca mines be valuable or not, we do not know. We do know, however, that this kind of 'reading notice' or 'write-up' masquerading as literature is injurious to legitimate mining business and journalism. That little word *Advt.* is often required to put supposititious news on a proper basis.

Royal School of Mines.

At the recent dinner of the present students it was made evident that the traditions of the Royal School of Mines have been transmitted from year to year with undiminished vitality; indeed, we may say, with augmented vigour. A series of events has tended to intensify the sentiment at the back of the insistent demand for a preservation of the identity of the old school, which has finally escaped becoming submerged beneath the combination of newer institutions of allied learning. The dinner to which we refer was held under the auspices of the Union, an organization that represents the consolidation of the former Mining and Metallurgical Society, together with the various athletic and social clubs by means of which budding engineers find a proper outlet for physical and gregarious energies. This Union, which is called the Royal School of Mines Union, is performing a useful service in preserving the esprit de corps of the mining students and in promoting the solidarity essential to the college life of a technical school. For some reason this Union appears not to meet with favour in the eyes of some of the authorities. A recent episode will illustrate: One of the professors was knighted on the occasion of the King's birthday, and when the students heard of the honour thus bestowed, they had the politeness to send a letter, by the president and secretary of the Union, congratulating the gentleman about to receive the accolade. He, however, with most unknightly discourtesy, briefly thanked them for their congratulations and then proceeded to ask by what right they had formed a Union, stating that it was against the rules and regulations. Luckily, others connected with the administration at South Kensington have more sense and it is not likely that this tactless blunder will be endorsed officially. We mention it, not to foment a fuss but to instance how the ardour of the students can be checked so as to cause ill feeling, instead of being directed to useful purpose. Youth must have its enthusiasms, and if these warm the traditions of a not ignoble past, surely it is all to the good. Why not turn such useful energies to beneficent purpose? We appeal to the governing body at South Kensington to exhibit a generous spirit and to recognize cheerfully and always, not grudgingly and occasionally, the identity of the Royal School of Mines. On the other hand we appeal to the students, both past and present, to recognize facts and "play cricket." After years of agitation and unrest, the two fundamental demands were granted, namely, the preservation of the identity of the Royal School of Mines, and the perpetuation of the degree of A.R.S.M. These concessions were all that the majority of the former students expected and their views found ample expression through the committee of the Institution of Mining and Metallurgy, which took the matter in hand. Unfortunately the R.S.M. had no alumni association, the old students were not a unit, they had no sort of organization except the annual amenities of a dinner, and they must now honourably support the scheme to which they gave their acquiescence. It is no use to kick against the pricks; the thing is an accomplished fact. We do not like it, we regret to see the identity of the R.S.M. veiled behind the Imperial College, for we would have preferred a separate institution; but this was impossible under the terms of the endowment and in the face of public apathy to the importance of mining education. It only remains to accept the situation and make the best of it. The old students should feel gratified that the mining and metallurgical departments are better equipped, both as to apparatus and professors, than ever before. The present students can be as loyal to the old name as they like but they should also be reasonable in their recognition of the fact that the R.S.M. is now a part, an integral and useful part, of a larger institution. Let us discard these belated antagonisms—and the medicine is as unpalatable to the writer as to some of his readers—in order that the efficiency of the R.S.M. may not suffer. The reputation of the School is made not in the class-room but at the mine, not at South Kensington but in all those regions where the men of the Royal School of Mines prove that they are fitted for positions of honour and responsibility.

Rand Metallurgy.

With regard to the zinc-dust method of precipitation, mentioned by Mr. T. Lane Carter in his review of Rand metallurgical practice, appearing in our September issue, it will be remembered that Mr. H. S. Denny, in our October number, expressed his astonishment that this method had not been adopted on the Rand. We now learn, from our Johannesburg correspondent, that this mode of precipitating the gold in cyanide solutions has been tried with some thoroughness. Experiments were made for the Eckstein group at the Geldenhuis Deep by Mr. S. H. Pearce, who had seen the process in the United States, and Mr. K. L. Graham. Mr. Pearce is not prepared to state that the system has been proved conclusively to be a failure under local conditions, but he admits that the results obtained from his experiments were unsatisfactory. His experience was particularly unsatisfactory in dealing with the weak slime solution (0·01 KCy), and he stated publicly that he found, unless cyanide was added to solutions at an extravagant rate, precipitation with zinc-dust was too slow. In its local application, the process, moreover, does not commend itself because the ordinary lead-coated zinc-shaving, when ceasing to be active in the weak solutions, can be readily transferred to other boxes used for the stronger solutions from the sand-plant. The contributions of Messrs. A. J. Clark and R. Linton to the Chemical, Metallurgical, and Mining Society of South Africa on the question of zinc-precipitation have done a great deal to revive interest in the possibilities of the method. Another interesting point in current Rand practice is the attainment of exceptionally high stamp-duties. It is unfortunate that more explicit technical information is not available as to the conditions under which it has been found possible to double ordinary stamp-duties at the West Rand Consolidated. The experiments have been conducted with heavy stamps, but the announcements made of results expressed in terms of bare duty naturally fail to excite such interest as the details of the coarse-crushing experiments undertaken at the Knight's Deep. There, we understand, work has been performed with a view to determining the economic limit of coarse crushing when adopting definite ratios of stamps to tube-mills. So far, it may be broadly stated, 9 mesh is economically the maximum limit, with a stamp-tube ratio of 20:1. With this screening and stamps weighted from 1400 to 1500 lb., a duty of nearly 15 tons is attained. Existing mills are designed on a ratio averaging one tube-mill for 40 to 50 stamps, though the Village Deep now stands at 1 : 30. The ultimate value of these coarse-crushing experiments is not widely realized at present, for few companies on the Rand today are running at full pressure and fewer still are prepared to incur expenditure upon further auxiliary plant of any description. The designers of new equipments will proceed warily until the mines are in a better condition to keep the ore-bins full. It has been pointed out with satisfaction that the Knight's Deep experiments are being carried out under the auspices of the new Mines Trials Committee, which must gain some share of the credit. The tests, no doubt, would have been made without the aid of that body, but the co-operation of the groups gives promise of more rapid and less wasteful progress than could be achieved under former disorganized conditions.

Coal Development in Alaska.

Again there is trouble over the coal-lands of Alaska. Attention has been drawn to the matter in a lurid manner by the wide publication of an article by Mr. L. R. Glavis, attacking Mr. R. A. Ballinger, the Secretary of the Interior, for his decision in certain contentious cases. As our readers are aware, the American laws governing the acquisition of public land containing coal have long been in need of revision ; they were the outgrowth of the older scheme for land alienation, which was based upon the idea of giving each settler a homestead. Accordingly the amount of coal-land any one person might buy was sharply limited; in fact, the area was entirely too small to warrant development in those inaccessible portions of the public domain where the exploitation of mines involves the building of railways or other expensive means of communication. Hence it became customary to take up large tracts by means of dummy entry-men who, on securing patent, transferred their holdings to a single individual or company, which then built the necessary railway. All this was plainly illegal, but it is often easier to disregard than to change a legislative enactment, and the custom was of long standing. During the administration of Mr. Roosevelt this practice was stopped, and numerous areas of lands so taken reverted to the Federal government. In Alaska the matter has just come to a focus. The country certainly needs development; both the opening of coal mines and the building of railways are clearly essential. At the same time there was no strictly legal method by which coal-land could be located on such a scale as to afford basis for profitable enterprise. The old expedient was, therefore, it is charged, resurrected, and in the interest of the Guggenheim-Morgan combination, which is building the Cordova & Northwestern railway, a filing was made on a generous slice of Government coal-land. Mr. Glavis, an inspector for the Department, since removed by Mr. Taft for insubordination, refused to pass the claims to patent and Mr. Ballinger, who in the interval between serving as Commissioner of the Land Office for Mr. Roosevelt and becoming Secretary of the Interior for Mr. Taft, acted as attorney in the interest of some of the claimants, is said to have used his position to advance the claims to patent. Congress, in 1908, passed an act intended to be curative as to all claims "taken up in good faith," and this is evidently at heart a question as to what constitutes 'good faith.' We have gone into details, since the episode touches the whole problem of the future attitude of the United States toward its mineral lands. The Conservationists hold that it is no longer necessary to give the land away to secure development. Anyone, however, familiar with the difficulty of enlisting capital for large enterprises in Alaska, may be permitted to reserve a small doubt as to the universal application of this dictum. It seems likely that these direct public charges against a member of the Cabinet will force through Congress an adequate revision of the coal-land laws. That, after all, is what is needed.

Broken Hill Slime.

Our Melbourne correspondent sends important news relating to Mr. E. J. Horwood's process for treating Broken Hill slime. The treatment of the intimate mixture of zinc-lead sulphides has proved a problem difficult to solve. Results have come slowly. Despairing of fire or leaching processes for treating the raw ore, the metallurgists who had the matter in hand fifteen years ago turned to the use of jigs and were content to produce a commercial silver-lead concentrate containing only one third of the metal in the ore. Subsequently, the flotation processes made it possible to treat the sandy tailing containing most of the zinc of the original ore, by removing the heavy gangue, with subsequent separation into zinc and lead concentrates. This improvement constituted a metallurgical advance of great importance, but it left untouched the great masses of slime discarded from the first concentration. The slime contains lead and zinc in nearly equal proportions and the sulphides when removed from the gangue would have to be separated in order to make smelting products. At the present time there is no device that will effectually separate the sulphides in the form of fine slime, so that all attempts as yet to handle this mill-product have been futile. In some quarters the idea prevails that the separation of sulphides from the gangue cannot be completely effected by means of flotation processes when the gangue is so fine that it will not settle; doubtless the problem is not as simple then as the same treatment of sand, though by careful regulation of the action at the skimming-lip the amount cf slime-gangue extracted with the sulphides need not be large. The method proposed by Mr. Horwood, who is 'works-manager' for the Broken Hill Proprietary, introduces a new method of separation. His idea is to roast the slime in such a way that the lead is sulphatized or oxidized while the zinc is not affected. The product then obtained is amenable to the flotation processes. The unaffected zinc sulphide can be floated off, leaving the sulphate or oxide of lead behind. Both the zinc and the lead are thus recovered in a form adapted to smelting. The process, of course, depends entirely upon the method of regulating the roast, and of this no details are as yet to hand; the fact that it has been evolved by Mr. Horwood is some criterion of efficiency. Metallurgists will await further details with great interest, for this new departure will put a finishing touch to the metallurgy of Broken Hill ores.

Flotation Patents.

"'What is truth?'" said jesting Pilate, and would not stay for an answer." "What is a mineral?" asks the Chancellor of the Exchequer, and smiling puts the question by. "What is a gangue?" interjects the perplexed Judge, when called upon to adjudicate on a subject with which he is not familiar. "What is a patent?" asks the judiciary of the House of Lords, having reduced No. 6519 of 1901 to a freely flowing pulp.

We are compelled to agree with the late Master of Trinity that "if you want to arrive at intelligible issues—not to say conclusions—in any discussion, begin by settling the meaning of the terms you are going to use." Therefore we submit that in law a 'mineral' is rock of economic value, in metallurgy a 'gangue' is the non-metallic matrix of metallic minerals, and in litigation a 'patent' is the illusive protection given to inventors. Having hazarded these three definitions we proceed to the discussion of a recent event of great interest to the mining world. We refer to the judgment of the House of Lords in the celebrated case of the Minerals Separation Ltd. *v.* the British Ore Concentration Syndicate, Ltd., and

Alexander Stanley Elmore. On another page we give an abstract of the decision, in which it is held that the Sulman-Picard-Ballot flotation process, as described in British Patent No. 7803 of 1905, is not an infringement of the Elmore acid patent No. 6519 of 1901. By implication the Court rules that the 1901 patent cannot be deemed the master patent of all flotation processes using oil and acid. The case is extremely complicated; a complete history of it would record the conflicting opinions expressed by judges in various courts, all of which exhibit palpable signs of perplexity in adjudicating concerning facts the cause of which it is beyond the ability of even chemists and physicists to explain to anybody's satisfaction save their own. Briefly, the oil-flotation processes, from the first patent of Carrie J. Everson, have been advanced and improved successively by the thinning of the pulp, the recognition of the selective action of oil, the addition of acid to increase this action, and the buoyant effect of bubbles. In the recent case the Sulman-Picard-Ballot development of the process, using an insignificant amount of oil and acid to agglomerate the mineral and depending upon the rising bubbles for flotation effect, has been declared outside the general claim of the Elmores for a master patent covering all applications of oil and acid. This lawsuit does not include or affect the vacuum process, which is another, and highly successful, invention due to the Elmores. Indeed, we hope that the profitable application of the vacuum process, now in operation in many parts of the world, will compensate its inventors to some extent for the loss arising from the recent litigation. Messrs. Frank E. Elmore and A. Stanley Elmore will receive the sympathy of metallurgists; this is not the first time that inventive chemists have been denied the full reward of long-continued research. Messrs. McArthur and Forrest underwent a severe baptism of litigation over their fundamental cyanidation patents. It is true the selective action of oil and acid was not unknown before the Elmores exploited it, yet the practical application of the principle is due to them, and their work has formed the basis for the modifications and improvements introduced by later investigators. In such matters the chemical fact has no economic value until it receives metallurgical application. Any number of people knew that the precious metals were soluble in potassium cyanide, but it remained a useless bit of knowledge until Mr. McArthur and his partner proved that extremely weak solutions such as were economically available were competent to perform the leaching precedent to precipitation of the gold and silver in ores.

The question once more arises as to the actual value of a patent. A patent may be drawn so precisely that a rival inventor will have no difficulty in producing a sufficient variation without altering the principle of the process; whereas if the specification is vague there is the risk of the patent being declared too broad. Then again if the patentee sells a license to his process, the intending users are stimulated to seek for modifications that will get rid of the royalties. In some cases he will find people ready boldly to annex his process or a colourable imitation, being rich enough to risk a long lawsuit, and quite willing to incur law costs that are negligible compared to the royalties saved. If an inventor applies his process himself at a metallurgical works, either his own or where his services are properly valued, the profit will come from the results, but even here he is not quite safe from imitators or from people who may wish to serve him with writs for infringement. The same holds good if he buys a mine or a tailing-heap. Besides, not every inventor can afford to erect his own mill or buy mines and tailing-heaps. We are loth to be reduced to recommending an inventor to keep his process a secret; that is against the public good. Our only alternative suggestion for the benefit of inventors is that patents should be interpreted from the point of view of common knowledge and practice at the time of application. In English patent law a patent or other printed notice over 50 years old is not deemed an anticipation unless evidence can be brought to show that the invention was actually worked, and there are many people—including judges—who hold that this principle should not be limited to 50 years. We think also that examination by qualified experts should be made before the patent is granted, as is the case in Germany. Opposition should not be left to rival patentees, and the disputes between the parties should not be left to courts where the judges have no acquaintance with the matters in hand. Justice is not always on familiar terms with Science.

Proper Procedure.

It is gratifying to observe that proper notions of procedure in mining finance find expression even in the untechnical daily Press. Thus the financial editor of that most excellent newspaper *The Westminster Gazette* raised the objection that official information of a technical character concerning the Brazilian Gold Fields should not have been issued without the imprimatur of a competent person. Our contemporary says: "News of this character should not be circulated unless it is vouched for in the name of a mining engineer whose views carry weight." This is a rule too often disregarded, and we rejoice to see it endorsed from such an influential quarter. In consequence of the *Gazette's* protest, the company made known the fact that the information published was to be credited to Mr. T. H. V. Bower, a former manager for the Brownhill Gold Mining Company, and a member of several engineering societies. Thus the contention was sustained that "when opinions are given on technical matters, they must be vouched for by technical people." We congratulate *The Westminster Gazette*; insistence on proper procedure is a service to the public. It is also an appropriate recognition of the mining profession as the natural protector of those who place their money in mining ventures. We go a little further. The reports and speeches of non-technical secretaries, directors, and chairmen have only an honorary value until they are tied to the facts and opinions furnished by technical men properly engaged to give advice. Unfortunately it is too often the case that when affairs are rosy the non-technical officials of a company pose like pouter pigeons and when things go wrong they find a scape-goat in their consulting engineer or manager. The public should learn to give both praise and blame, both credit and discredit—in a word, the responsibility—to the specially qualified men without whose experienced direction all mining and metallurgical enterprises are merely childish adventures. To this end we suggest that those who report on mines should affix to their names not only the luminous appendage of alphabetical distinction and professional membership but a precise mention of the mines previously managed. Not many men are fitted to pass judgment upon the value of a mine or to diagnose its physical condition until they have themselves undergone the particular kind of experience obtainable from resident mine management. We are aware that one or two men, still comparatively young, have won deserved reputation by skill as mining experts without the previous training given by the daily routine and the intimate acquaintance with details inseparable from the work of a mine-manager, but such cases are exceptional. They are examples of professional evolution *per saltum*. We do not commend the practice of asking samplers to appraise mines; we do urge the recognition of a thorough apprenticeship and the acknowledgment of mine management as the best preparation for mine-appraisal. Therefore when engineers report on mines, let them say what mines they have managed.

While disposed to honour the distinction of M.I.M.M., M.A.I.M.E., M.I.C.E., and especially that of A.R.S.M., we think more of the man who can claim to be the successful manager of the Robinson, the Waihi, the El Oro, the Homestake, or other mines far less known to fame that have served as the incubators of engineering talent.

The Rights of Shareholders.

According to despatches from Johannesburg, Mr. L. Reyersbach, a member of the firm of Wernher, Beit & Co., and a director influential in South African and West African mining affairs, has suggested before the Transvaal Chamber of Mines that the mining companies shall cease publishing monthly reports, confining their publication of information to the issuance of annual statements to shareholders. It is not remarkable that a suggestion so serious and emanating from a source so authoritative should have provoked protest. The financial Press has recorded the objections offered by influential Stock Exchange firms and has published cablegrams from Johannesburg indicating that the East Rand Proprietary, General Mining and Finance, and other important companies refuse to adopt Mr. Reyersbach's proposal. It is well that public opinion should be awakened to the danger of such a relapse from proper procedure, for it would involve a reversion to the methods in vogue before the public established a right, as shareholders, to receive full and frank information concerning the mines owned by them. This right is acknowledged today, although it may be evaded occasionally by directors either negligent of, or unfaithful to, their responsibilities as trustees. It is much to be regretted that the new partner of a firm so honourably eminent as Wernher, Beit & Co. should, at this late date, express an idea calculated to hinder that real publicity to which legitimate mining owes its improved repute. Ostensibly the purpose of ceasing the publication of interim reports is to promote economy. At the Gold Fields meeting Mr. E. Birkenruth said that "it is debatable whether the company should publish so many details as they do." Thus this pernicious suggestion of secrecy masquerading as economy has been made by two of the leading financiers operating in South Africa. Of course, the non-publication of details will save no money worth mentioning; the cost of a detailed report is not in the publication but in the collection, compilation, and comparison. Companies like the Consolidated Gold Fields and Rand Mines necessarily keep a detailed record of costs and of their technical operations, primarily not for their shareholders but as the very foundation of administrative intelligence, without which the management would be in a fog of surmise. Accurate tabulation of comparative data is essential to clear understanding of a business so complicated as mine exploitation and it is well recognized that the expense incurred is repaid many times by the fierce light thrown thereby upon the fluctuating character of operations. To run a mine without up-to-date statistical information is like building a smelter without carefully prepared drawings. Whether the shareholders get the information or not, it must be prepared. Apart from serving as a necessary guide, such comparative data have additional value as a stimulant to efficiency among the managers and other members of the staff. The monthly statistics recorded at the office on the mine and in the mill afford a basis for comparisons as discreditable to poor management as they are creditable to good management. Thus the members of the staff, from the shift-boss to the general manager, are put on their mettle and are kept to a high pitch of efficiency. That is the chief use of statistical mine-records—that, and the safeguarding of the shareholder's interest by tne frequent transmission of reliable reports of progress. By the aid of printing and postage the secondary duty becomes a sequel to the primary purpose of such reports. The additional cost of publication is as nothing in the performance of such a service. If directors suggest that shareholders will save money by the discontinuance of monthly reports, they speak with a tongue in their cheek, they are soliloquizing under their sombrero, they are "talking through their hat." It is buncombe.

But there is economy in dropping the publication of monthly returns in another and a thoroughly practical direction : The monthly statement entails the effort to maintain a uniform output; this is helped by a gold reserve and by the accumulation of broken ore, but it is effected mainly by drawing the output from stopes of varying grade in order to make a mixture of average tenour. Such uniformity of production requires that several portions of a mine be worked concurrently and it imposes expenses that could readily be avoided if only an annual statement were deemed sufficient. It is *not* deemed sufficient and the expense incurred *is* deemed worth while, for the obvious reason that twelve months of silence as to the progress of operations would afford ample opportunity for those malpractices from which mining has slowly emerged.

What is a Mineral?

The question as to the definition in law of the word 'mineral' has formed the subject of another decision in the courts, and from the general point of view the decision is quite at variance with a large number of previous rulings, inasmuch as it expressly states that the common rock of the country, unless it contains something exceptional in point of higher value or rarity, and notwithstanding that it may be useful for building purposes, cannot be classed as a mineral when arguing as between surface rights and mineral rights. The five eminent judges composing the tribunal in House of Lords were unanimous, and their decision must be accepted as an authoritative pronouncement upon the subject. At the same time it cannot be regarded as an epoch-making decision, because it is merely the logical corollary of the proposition enunciated in a previous case, which came before the judicial committee of the Privy Council in 1887.

The case in point arose out of a dispute between the North British Railway and the Budhill Coal & Sandstone Co. The latter company is lessee of the minerals in certain land between Edinburgh and Glasgow over which the railway runs, and claimed the right to work the sandstone found in the subsoil. The stone had indeed been worked, and had caused a subsidence of the railway line. In the first and second Scottish courts the Budhill company had won its case, relying on the clause in the Scottish Railway Consolidation Act of 1845, which reserves from the company buying land "any mines of coal, ironstone, slate, or other minerals." The House of Lords did not attempt the impossible task of reconciling the conflicting rulings of inferior courts, but decided the case from what the Lord Chancellor described as a "common - sense standpoint" and held that by the words "other minerals" exceptional substances were designated, and not the ordinary rock of the district. As to whether exceptional substances are minerals, the view was expressed that the Court has to determine what the words 'mines' and 'minerals' mean "in the vernacular of the mining world, the commercial world, and landowners" at the time when the transaction is entered into, regard being paid to whether the particular substance was then looked upon as a 'mineral.' Each case will therefore be judged on its own merits and in view of the circumstances immediately affecting it. In former days 'mineral' meant the substance won by 'mining,' which in old times meant subterranean excavation. Of recent years scientific methods have been applied to the examination and recovery of the rarer substances of the earth, with the result that the word 'mineral' has almost acquired a meaning of its own independently of any question as to the manner in which it may be gotten. Neither etymology nor science can determine what is a 'mineral.' It is a question of fact dependent upon the general acceptance and meaning of the term among those accustomed to use it—that is to say, in mining, commercial and landowning circles. As was said by the late Duke of Argyll, the true definition of a word must be based upon "a report on the facts," that is, a statement as to what the world in general means when it uses that word. Words stand not for what the speaker or the writer means, but for that which his hearers or readers understand them to symbolize.

Counsels of Imperfection.

In a recent issue of the *Mining and Scientific Press* we find an abstract of the address delivered by Mr. John Hays Hammond before the Colorado School of Mines. This address is interesting both on account of the advice given to the students and by reason of the distinction of the speaker. To his young hearers the career of Mr. Hammond must have seemed nearly the ideal of their budding ambitions, for to no American engineer has it been given to play so striking a part in the economic and political events of the last twenty-five years. The advisor of Cecil Rhodes and the friend of William H. Taft, the professor of Yale and the millionaire of New York, has certainly played many parts and he has played them with commanding success. The cynic may say that "nothing succeeds like success," but there remains the irrefutable fact that success in the scheme of creation presumes the possession of those qualities most useful under the conditions in which we live. But it does not follow that the successful man can place his finger on the factors that made him so successful. The onlookers see most of the game, and as an onlooker we demur to Mr. Hammond's notions of the code of professional conduct most conducive to a fortunate career as presented to students about to become mining engineers. In Mr. Hammond's address we find much that calls for concurrence but more that evokes disagreement. He thinks that he speaks as a mining engineer, but he talks as a promoter. The voice is that of the philosopher but the hands are those of the financier.

As a first essential to "professional success in mining," Mr. Hammond places "the possession of character." From the context we infer that the speaker meant fixity of purpose rather than benevolence of disposition. Undoubtedly intelligent persistence is a prime essential. Indeed, we agree with Mr. Hammond in placing the relative value of a technical education at only 25% as compared to 75% for level-headed perseverance. But short-cuts are to be avoided; he deplores the tendency of young men to assume large responsibilities before they have served an apprenticeship. This is a failing only too common, and is due in part to the extraordinary success of one or two exceptional men who skipped the years of preparation before undertaking highly important and highly profitable tasks. Next comes a reference to the old-fashioned type of report, which was confined to purely technical questions, overlooking the fact that the purpose of mining is to make money, and not to provide geological or metallurgical pamphlets. It is proper and useful to lay emphasis on the interplay of the technical, commercial, and financial factors in mining. Here Mr. Hammond is on firm ground, for to the recognition of these fundamental relations he himself owes much of his success. So far, so good. Next the mentor of the students tells them that he has "strongly advocated the evolution of the engineer and expert into the 'mining man.'" Yes; he has advocated it, but not strongly nor convincingly, and his latest attempt to advocate such views will, we hope, make but few converts. Of all the vague, loose, and objectionable terms for a definitely useful leader of industry commend us to 'the mining man.' This term includes the shareholder and the manager, the metallurgist and the surveyor, the highly skilled and the least skilled, the honest operator and the fraudulant faker, the man who loafs in a mining-town hotel, the 'gent' who presides at the faro table, the entire flotsam and jetsam of humanity discarded by the tide of mining speculation, the captain of industry and the *chevalier d'industrie*. It is preposterously indecorous for a past President of the American Institute of Mining Engineers to say that the engineer and the expert ought to be metamorphosed into that elusive commonplace 'the mining man.' However, this is a small matter; it is an obvious blunder, and will not go far. But the next injunction lays Mr. Hammond open to the charge of either insincerity or perversity. To "mine promoters" he "ascribes the failure of many mining enterprises." They are an ignorant lot; he "would like to see the mining engineer acquire such a knowledge of business methods as to enable him to take the place of the mine promoter." That is what we least would like to see. Mr. Hammond is aware of this also, for he refers to criticisms offered on the occasion of a similar pronouncement of his about a year ago in his address as president of the Institute. He does not defend his opinion but asserts: "The aim of mining is to make a profit in the exploitation of ore deposits, and I do not believe that the function of the engineer should be limited to the consideration of the academic features of mining problems."

It is a pity that anyone likely to carry authority among the youngsters of the profession should say anything so radically unprofessional in spirit. The difference between a professional man and a day-labourer is that the first loves his work and aims to do it well, for its own sake, while the second looks upon labour as a necessary evil. The engineer delights in accuracy, in the control of natural forces, in the application of knowledge to useful ends, and if the performance of duties so agreeable to his training should result in financial gain, so much the better. But gain is subservient to excellence. A surgeon performs an operation with equal skill and care whether his patient be a pauper or a duke, whether his fee be in tens or hundreds of pounds. Any doctor or surgeon who allowed the idea of profit to dominate his actions would be deemed recreant to his calling. We grant that there are men in every profession who sacrifice ideals to commercialism, but shall we hold them up to the young as models to be imitated? The aim of mining is indeed "to make a profit from the exploitation of mineral deposits" but the aim of engineers is not only to make money for themselves but to do good work, to give trustworthy advice, to erect economical machinery, and to administer affairs in the interest of their clients. These functions include many duties besides the "academic" solution of problems, and it is a curious distortion of ideas to suppose that between the academic and the financial there is no scope for mining engineers. We were simple enough to believe that the ideal mining engineer was neither an academic solver of problems nor an enterprising promoter, but an educated man applying science to industry in an economic manner. If mining engineers occasionally participate in financial schemes and make money by commissions on the sale of mines, that is their affair; it is quite a different matter for them to advise others to follow their example. Then they lay themselves open to criticism. The participation of engineers in mine-promoting and stock-jobbing may be inevitable but it is none the less regrettable in so far as it tends to undermine the ethics of the profession. Some men participate in this dangerous game without loss of character and without impairing their judgment, but such exceptions neither constitute a rule nor present the best sort of example for youngsters. Mr. Hammond has given counsels of imperfection; neither by example nor by sympathy is he well adapted to pose as adviser to young men about to become mining engineers; but if he should deliver a lecture on how to make money in mining, he would be assured of a large audience not of young men only but of directors, bankers, and financiers long past their adolescence.

West Africa.

We are glad to have been able to persuade Mr. E. T. McCarthy to give an account of his early experiences on the Gold Coast and to contribute a few facts concerning Bonnat, the pioneer in the development of West Africa. This fragment of history will be appreciated by those who have proved that the pick is mightier than the sword in the subjugation of the jungle. Our imagination is stirred even by brief references to the obstacles against which the mineral explorers had to contend and the losses they had to face, not the least of which was that living death befalling those who are cut off from their kith and kin. West Africa twenty years ago when white men single-handed penetrated the tropical forest was a different country from the region now industrialized by steam and electricity. Mr. McCarthy is too modest to dwell at length upon his experiences when invading the bush in search of gold mines; in this he is like most engineers, who are so possessed with the purpose in view, so concentrated in the accomplishment of that purpose, as to have no time for scattering themselves in appreciation of the scenery or introspective records of their feelings as they push their weary way through the entanglements of unrestrained nature. Yet the tropical splendours through which they trudged to their El Dorado provided a setting as romantic as it was fearsome. Off the beaten track, a little to one side from those winding trails that now thread the primeval bush, the traveller can plunge into the gloom of Nature's inner shrine, where life and death ever contend for mastery, where the rank growth of vegetation encloses the swift death of poisonous insect, predatory beast, and even more fatal fever. Ants of portentous size stir the leaves underfoot and dig those winding tunnelings that simulate a snake. Bright butterflies catch the light in glades where a storm has uprooted trees and cleared a space, now carpeted with moss, in which the tall ferns find root. The trees are festooned with living rope or *lianas*, entwining the forest in loops of green. Brilliant orchids are perched aloft in frail beauty, contrasted against the dark leaves of the rubber climbers and the white trunks of the silk-cotton trees. Strange perfumes, both sweet and horrible, emanate from flower and fungus, awakening another sense to the realization of conflict between the beneficent and the malificent. Dank mists robe the vistas in gloom in the early morning, until the hot sun penetrates the foliage, irradiating the myriad multicoloured life struggling on the humid earth. And at night, the wonder is intensified, for then the beasts that slink away from the invader during the daytime come prowling about his temporary dwelling. He is in a Noah's Ark of mingled savagery. Civilized man is made to realize his isolation. The bark of the jackal and the howling of the wolf are less awesome than the purr of the panther or the symphonious too-tooing of melodious bats flying in big flocks far overhead. The hooting of the little tree-sloth rasps the nerves and the crawling of big spiders tends to banish sleep. The cuckoo may sound like home, but the laugh of the hyena smacks of the infernal. Yet even in this welter of naturalism the strong man, wearied by his day's work and callous to the dangers about him, will sleep like a child, and awake—valiant in mind and body—to fulfil his destiny. Mining engineers and mineral explorers are not commonplace heroes; they are the pioneers of empire and the scouts of industry.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Stope-Drill Competition.—The figures published showing the drilling efficiency of the stope-drills still running in the competition clearly prove that a high speed is attained, but more general data relative to the lessons of the tests have lately not been forthcoming. With the present acute labour shortage many mines that have not anticipated official verdicts by introducing their own small drills are anxious to learn the results of the trials to date from a broad economical standpoint. If the drills are recording small fathomages, it may of course be due to the fact that the men operating them are 'drillers' rather than miners, and if they are expert machine-men, how would the machines show up in the hands of the mining rank and file? Mr. Tom Johnson has lately been appointed manager of the competition. A more capable underground man could not have been found and he is certain to give the industry the benefit of valuable conclusions and ideas. It is only when Mr. Johnson discusses the political or social side of mining that his opinions fail to be convincing.

City Deep Mill.—The foundations of this mill, which is to have an initial capacity of nearly 800,000 tons per annum, have been finished, so that it may be said that the surface equipment of the City Deep mine is now well in hand. This wonderful property will be one of the "show mines" of the Rand. It has already 1,500,000 tons of ore developed, with a value of 8·9 dwt. Allowing for the assay-plan factor, sorting at 15%, and developed ore, this should mean a yield of about 35s. per ton, or well over £100,000 per month. It is remarkable that all Main Reef Leader development to date should thus represent a yield per ton of 40% more than that of the adjoining Village Deep.

Sand-Filling Experiments.—The photograph published herewith illustrates the quantity of sand (cyanidation residue) already sluiced into the Robinson mine for stope-filling. The system has only been commenced experimentally by means of a wooden launder (6 by 6 in.), which can be seen in the photograph just as it enters the 40 to 50° pass, leading direct to the wide stopes nearly below the mill. When the scheme is more widely extended, pipes will doubtless be used as in German and American coal mines. A modest plant is all that is required for initial work at the Robinson for the reason that the dip of the lode is steep and the sand packs itself well, without the necessity of a heavy head of water for distribution. At present the only requirement is to get the sand down and there is little need for lateral transference. If it could be dropped down vertical passes, without added water (as at Kalgoorlie) immediate requirements would be served.

Sand-filling of stopes at the Robinson Mine.

Development.—This branch of mining is the first to suffer from the local shortage of labour. Yield and profit must be maintained, of course; so the machine-drills are taken out of the drifts and put on stope faces, to take the place of the vanishing hammer-boys. During the last few months, there has been an appreciable reduction in the aggregate development footage (or mileage, as it might well be expressed). Government statistics show a total of 88,748 ft. in September, against 92,493 ft.

in August and 93,633 ft. in July. These records will be worth watching. When development gets behind, the trouble begins, but fortunately the majority of Rand companies are able to claim magnificent reserves, more or less available for stoping, and are well prepared for trouble.

German Diamonds.—Dr. Marloth, President of the Cape Chemical Society, has expressed his opinions as to the origin of the diamonds found in German Southwest Africa and opposes the views of H. Merensky, appearing in recent transactions of the Geological Society in South Africa. It has been contended by some that the stones have travelled down the Vaal and Orange rivers from the known sources of production, together with the water-worn agate pebbles commonly associated. Dr. Marloth does not favour this theory either, but supports J. Kuntz, who has declared: "It is possible the agate pebbles do come from the Orange river, but the diamonds have probably a nearer source, which is at present either hidden by the sea or still to be discovered in the desert near by." The latter hypothesis should stimulate serious prospecting and the former should provide attractive possibilities for syndicate promotion, with a view to the organization of geological diving parties, to those Transvaal speculators who have lately been drilling blindly for the Rand's auriferous sea-beach deposit through the depths of unconformable overlying formations.

Government Rights.—The water-rights and *bewaarplaatsen* (depositing sites), whose mining privileges are in the hands of the Government for disposal, have not yet been sold to the interested companies. Fully six months ago it was rumoured that the question had been satisfactorily settled, but this appears to have been unfounded. It is not known where the obstruction lies—whether in the valuations or the basis of settlement; the long delay is certainly not gratifying from the public standpoint. Negotiations might well have been concluded some months ago when times were so good and when there would have been less chance of haggling or deadlocks over trifles.

Rooderand.—The attempted revival of the Rooderand Gold Mining Co., whose property lies in the Venterskroon district on the Vaal river, is an interesting sign of the times. This locality, which comprises a portion of the southern edge of the Witwatersrand formation and includes many auriferous conglomerate beds, had its 'boom' in the middle nineties and was at that time found too poor for successful mining. Since then prospecting has mostly been of a spasmodic and half-hearted character, winning back for the district little of its lost favour. The Rooderand is the principal concern, and holds to-day, as ten years ago, the pick of the line. Only two years ago a portion of this company's mine was allowed to lapse into 'open ground,' but it has presumably been re-pegged. Reports are now current of new finds or, at all events, new valuations. J. Hoffman and Dr. Jorissen have been advising the company. It is unfortunate that their reports, if any have been written, are unavailable. The official conclusions are expressed in a manner that can scarcely win confidence. An announcement, following the words "The Secretary states . . . ." contain some strange remarks: "Mr. Hoffman and Dr. Jorissen agree that the reef on which the payable results have been found belongs to the Witwatersrand Main Reef system." This is something quite new in South African stratigraphical terminology. The Main Reef series of conglomerates, lying at the base of the upper division of the Witwatersrand system, is of sufficient economic importance to merit pages of laudation, but to elevate it to the rank of a geological system is a blunder. Later, reference is made to a "new reef," traced for 2000 ft., of which 1000 ft. average a "yield" of 5 dwt. over 3 ft. 5 in. and the other 1000 ft., 4·5 dwt. over 4 ft. This "is called, tentatively, the Middle Reef." There is something delightfully modest about this announcement. Note how conservative are those in control. The bed is called the "Middle Reef," not with autocratic arrogance, not with the positive assurance that it is the "Middle Reef," and nothing else, but merely "tentatively." It is perhaps an experiment pending the decision of an International Congress of Geologists as to the fitness of the nomenclature. In the old days, the numerous reefs of the Venterskroon district used to pass under the names of Odin, Meisters, Jumbo, Myrtle, Stink, Gordon Black, Springbok, Amazon, Great Western, etc.—names now forgotten like many of the ore-bodies to which they were applied. However, let the Rooderand company rest assured that, being a big concern with a capital of £250,000 and having discovered a "new reef," it is at liberty to employ a new name without the consent of the Union Parliament and that there is no need for tentative measures. Of course, the main point to determine is whether the valuation of 2000 ft. of this Middle Reef at an average "yield" of 4·7 dwt. over 45 in. is not also "tentative."

Diamonds. — The output declaration of the Premier Diamond Mining Co. for the half-year to October 31, shows that the 1908 scale of operations has been maintained. At present, no data are given as to sales and realized value per carat, which are, after all, the principal considerations in regard to the production of stones from so inexhaustible a source of supply as the Premier. Comparative figures for recent periods stand as under:

Year	Loads washed	Carats won	Carats per load
1905	1,388,071	845,652	0·609
1906	2,988,471	899,746	0·301
1907	6,538,669	1,889,937	0·289
1908	8,058,844	2,078,825	0·258
Half-year			
April 30, '09	3,633,165	938,387	0·258
Oct. 31	3,884,628	933,748	0·240

Working costs are now probably little more than 1s. 6d. per load; although this must be multiplied by four to give the cost per carat the influence of reduced expenses is of small account as compared with market fluctuations. The new plant will soon be ready; this will raise the capacity to about 15,000,000 loads per annum, equivalent to a yield of 3,750,000 carats. The prospects of this diamond deluge are such as to make one reflect with satisfaction upon the shortage of labour.

The gradual revival of the diamond market, discussed by Col. Harris at the Jagersfontein meeting may, in time, lead to the resuscitation of a number of hibernating concerns, for whose existence there is no real justification. Syndicates that proved abortive, irrespective of market conditions, are not unlikely to be revived by their promoters on the misrepresentation that only the difficulty of disposing of stones at a good price was the former bar to success. The Montrose Diamond Mining Co., now arranging to resume operations, does not deserve to be thus suspiciously classified, but it is not an enterprise of which local experts think too hopefully. That the main pipe could under the management of D. Draper, be made "to become before long a regular producer" is not questioned, if the needful working capital could be provided. The doubt lies in its ability to make regular profits.

Mineral Production.—Owing to the steady development of the tin mining industry, the production of base metals and miscellaneous minerals in the Transvaal is increasing. Recent returns of Governmental authenticity have been:

Month	Yield
July	£30,500
August	£33,692
September	£44,195

Fifty per cent. of this is represented by tin ore, Copper accounts for a few thousand pounds. The galena output is almost insignificant.

Troubled Managements. — While the great majority of Rand mines have shown creditable vitality in the times of difficulty associated with labour-shortage (the incidence of which by no means bears equally upon all, in spite of a nominally impartial labour distri-

Trommels and Sorting-Belts at the Village Deep.

bution), there have been several whose recent results have been unsatisfactory. Labour-shortage has not been the origin of trouble in all cases, but it has generally been a contributary cause. In six months, the profit of the Robinson Deep has fallen from £37,000 to £26,000; the New Rietfontein's from £6000 to £4000; the Simmer & Jack's from £57,000 to £50,000; the New Unified's from £5000 to £2900; the Consolidated Main Reef's from £8000 to £5000; the Roodepoort Central Deep's from £3000 to £1500; the Luipaardsvlei Estates' from £4880 to £1900; and the New Goch's from £14,000 to £10,000. The Aurora West, Village Deep, and Lancaster West have not been doing well. The French Rand and Geduld have operated under exceptional difficulties throughout the year. On the other hand almost as many mines have progressed during the period, notably, the Main Reef West, City & Suburban, New Modderfontein, Jupiter, Knight's Central, Knight's Deep, Geldenhuis Deep (since June), Village Main Reef, and Knight's.

East Rand.—An interesting theory, worked out by W. Bleloch, is being discussed in local geological circles. It attempts to smooth away various difficulties associated with East Rand stratigraphy. According to accepted ideas, the Main Reef series, traced through the East Rand Proprietary and Boksburg mines, outcrops (after its disappearance below the coal measures at the Rand Collieries and Van Dyk) on the Benoni - Kleinfontein ground. This correlation can be supported by the strongest data and is accepted, almost as a matter of course, in Hatch & Corstorphine's 'South African Geology.' The southerly trend of the outcrops at the Boksburg gold mines (presumably due to the erosion of the crown of an anticlinal fold at Witpoort) is assumed in the new theory to be the normal strike, while the Benoni-Kleinfontein - Modderfontein 'Main Reef' is taken to represent the Rietfontein horizon. This correlation, it is held, will account for the comparative thinness of the strata underlying the "so-called Main Reef" in the Far East Rand. That these are problems for solution in connection with East Rand geology is undoubted, but the present evidence in favour of the supposition mentioned is scarcely sufficient to revolutionize our conceptions or to force upon the Far Eastern mines the stigma of 'disestablishment.'

SAN FRANCISCO.

Utah.—Rumours have been persistent for a long time that Mr. F. Augustus Heinze had lost, or was about to lose, control of the Ohio Copper Co. in Utah, but it seems that he is more firmly entrenched than had been supposed. He is now on his way from New York to make an inspection of the mines at Bingham, and of the new mill, the first section of which will be started shortly. One object of his visit will be to contract for the sale of the concentrate. The original plans of the Ohio company include the construction of a smelter, and contracts with ore-shippers were entered into. These plans were completely overturned by the embarrassment of Mr. Heinze during the financial troubles of 1907 and 1908. It is said that bidding for the concentrate is active by the three great competitors in the smelting industry near Salt Lake City, namely, the Garfield Smelting Co., a subsidiary of the American Smelting & Refining Co., the United States Smelting, Refining & Mining Co. at Bingham Junction, and the International Smelting and Refining Co., which is constructing a smelting plant in Pine canyon, in Tooele county, just across the divide from Bingham on the western slope of the Oquirrh mountains. Active bidding for ores of all kinds by the Utah smelters is noticeable. Copper ores are in demand, and special inducements are being offered to the lead miners. The smelters are not working their lead-plants to more than half-capacity at present. The South Utah Mines Co. has been organized to take over the properties of the Newhouse Mines & Smelters corporation in Beaver county, Utah. The mine will resume operation at once, and the reduction plant, which has been extensively repaired and altered, will treat 1000 tons of ore per diem. The ore assays about 3% copper, and is comparatively easy to treat, a large percentage of the copper being obtained by concentration with jigs. Tests indicate an average extraction of not less than 80% of the metallic content. Another of the companies which was financed under the direction of Mr. Samuel Newhouse, of Salt Lake City, is the Boston Consolidated, owning a large area of mineral land near Bingham, and a 3000-ton concentrator at Garfield. The mines embrace copper veins yielding basic sulphide ores, capable of being smelted as mined, and also a large slice of the same disseminated 'porphyry' (monzonite) deposit which constitutes the basis of the operations of the Utah Copper Co. It has long been evident that the Boston Consolidated was in difficulty. The mine was not capable of supplying the concentrator with ore, or, at least, not at a cost which would admit of winning a profit. The effort to mine with steam-shovels did not prove satisfactory, evidently because of the variable depth of the 'overburden' of leached 'porphyry.' A caving method was introduced which had some interesting features, but the deposit was not blocked far enough in advance of mill-needs to admit of its economical and systematic application. Thus operations were pursued in a halting manner. Adits and levels at greater depth have shown a higher grade of ore, and so large a quantity is now said to be available that Mr. Frank A. Schirmer, treasurer of the company, and Mr. Hugh Jennings, consulting engineer, have recommended the enlargement of the mill to a capacity of 6000 tons per day. This, incidentally, is a pleasing vindication of the judgment of Mr. A. J. Bettles, mill superintendent, who insisted on using Nissen single-stamp batteries for crushing, instead of employing rolls and Chilean mills as was done in the neighbouring plant of the Utah Copper Co. The character of the ore from the two mines is not identical, that from the Boston Con. not requiring such fine comminution to liberate the copper minerals, and the stamps are said to leave the pulp in excellent condition to afford a high percentage of extraction. The recovery is claimed to be 75%.

California.—A revival of activity in gold mining in Amador county, California, on the famous Mother Lode, is assured. This is being brought about by a consolidation of the Keystone mine at Amador City, the Wildman-

Mahoney mines at Sutter Creek, and a number of intermediate properties, to be operated by the California Consolidated Mines Co. The Keystone has a record of production reaching the goodly sum of $17,000,000. Like many properties on the California gold-belt, the richer ores were worked, having low-grade ores which could only be treated by large plants handling an enormous tonnage. There are rumours of other similar consolidations to be made in California which may inaugurate a new era in the gold industry of the State.

Nevada.—The gold miners in this State are exercising ingenuity to evade the bullion tax, so called, which is in truth a tax on mineral output in general, the statute specifying "ores, tailings, borax, soda, or mineral-bearing material." The tax is not a definite percentage of net or gross value, but is assessed upon the net proceeds, which net proceeds are subject to contribution at the same rate *ad valorem* as other property is taxed. The net proceeds are the remainder after deducting the actual cost of extracting the ores or minerals from the mine, the cost of selling the same, or the cost of reduction, and sale of the refined product. Returns are to be submitted quarterly to the tax assessor, and no allowance is permissible for expenses incurred prior to the quarter for which the assessment is made. The regulation is not new, such a law having been in force practically ever since Nevada was admitted to the Union, but the question has recently assumed prominence because of the sudden and enormous expansion of the mineral industry in that State. From being an almost depopulated region, not without warrant referred to in politics as a 'rotten borough,' Nevada has become the scene of great enterprises, with busy towns and mining camps, and scoured by prospectors so that scarcely a canyon in its hills does not shield some searcher after nature's bounty. The great gold enterprises at Goldfield are so famous that Goldfield Consolidated stocks are traded in at Paris; the Pittsburg Silver Peak has been resuscitated and is operating on a splendid scale, with the promise of a great career; Ely has become one of the greatest permanent factors in the copper industry of the world, the Nevada Consolidated mining cheap 'porphyry' ores by steam-shovel, concentrating, smelting, and marketing refined metal at New York within a cost fluctuating between 8 and 9 cents per pound. The Pittsburg Silver Peak experienced difficulties with the tax collector that led to serious friction. The Nevada Consolidated has adopted a course which averted difficulties, and the Assessor of White Pine county in his report stated "the value of the total output of these companies (the Nevada Con. and Cumberland-Ely) for the quarter ending March 31, 1909, is given at $1,185,174, with an expense against this amounting to $1,145,812. I was given access to the accounts showing every item of this expense and with the exception of one or two very trivial and unimportant items I learned that these companies are not attempting to claim that the Steptoe smelter is a separate corporation charging extortionate rates for treating the ore handled; instead, the actual costs of treating the ore is the only charge made by the smelter." The attitude of the Nevada Consolidated has been praiseworthy, and is a model for other corporations to follow. The Goldfield Consolidated, according to rumours, has frankly met the demands of the tax collector, but has arranged that 20% per annum of the capital account may be deducted from gross profit for depreciation of plant. Confirmation of this report is lacking, but some adjustment has evidently been made. It is also said that the reduction plant of the Goldfield Consolidated will be turned over to a new corporation which will operate it on the basis of a contract rate per ton of the ore delivered from the mines of the holding company. This would legalize the deduction of depreciation by including such depreciation in the treatment charge, and thus preclude difficulties with future tax assessors.

TIENTSIN.

Another milling plant has been brought under operation in Korea, the mill of the Seoul Mining Co., of Hartford, U.S.A. (owning and controlling the Seoul concession, which was granted by the Korean government in November 1905), having commenced to run on October 20. The plant includes two 10-stamp batteries, 1050 lb., and one tube-mill, 22 by 5 ft., likewise one Richards pulsator-classifier and six James concentrating tables, etc., and has been made, shipped to the interier of Korea and erected within a period of one year from the date the order was placed with the Joshua Hendy Co. of San Francisco.

The orebodies thus far developed at Suan occur in metamorphosed Paleozoic sediments round the edges of a great granite batholith. These sediments consist of dolomitic marble overlying quartz schist. The granite is of a porphyritic variety, showing large phenocrysts of orthoclase. From a geological point of view, the formation is of great interest as it consists of a typicial and perfect example of a contact metamorphic deposit with a fine development of lime-silicate minerals. Long irregular lenses of ore and bunches of an average width of about 10 ft. are found lying in the sedimentary rock close to the granite contact. The ore consists of a complex silicate of lime, alumina, and magnesia; it contains little quartz, but shows some carbonate of lime. The copper is present principally as a chalcopyrite, but also as bornite.

Ore has been opened up to a depth of 450 ft. and for a length of about 1000 ft., that found in the last 20 ft. of depth averaging $25 per ton in gold and 3½% copper. In the western workings of the mine a body of high-grade ore about 30 ft. wide has been followed for a distance of 100 ft.; this averages $60 in gold and 10% in copper.

As the product of the mine does not permit advantageous treatment at the mill it is being shipped to the Tacoma smelter. About 150,000 tons of milling ore have thus far been developed ready for milling; this is expected to yield about $20 per ton in gold and copper. The concession covers an area of 20 by 13 miles and is granted for a period of 70 years, its issuance by the Korean government having been confirmed by the Japanese government. The importation of all mining machinery and material and the export of all products is allowed free of customs duties. The royalty to be paid to the Korean government is 1% of the gross receipts. The company is capitalized at $500,000 of which, however, it has only been necessary to issue $400,000. The Suan orebody appears likely to extend for a distance of some six or seven miles in the concession area, and in addition to some 9700 ft. of development already made on the Suan mine itself, a little work has been done at four other places within the concession limits, where encouraging conditions exist.

DENVER.

Geological Survey.—The first report of the newly established geological survey of Colorado is now available and makes an excellent impression. It is interesting to note that while the position of State Geologist was established as early as 1872, only in 1907 was any money made available for field-work or publication. Indeed even then R. D. George, the present incumbent of the office, was obliged to advance personal funds in order to enable field parties to take advantage of the summer season, and in the preparation of the report itself much of the work was gratuitous. The high character of the work itself is, because of these circumstances, all the more striking and is a noteworthy tribute to the professional interest of Mr. George and his associates. It was naturally impossible to cover more than a small portion of Colorado's great area. The tungsten belt of Boulder county, the Hahn's Peak and the Montezuma districts are, however, each discussed in some detail and illustrated with excellent maps. In addition, a general study of the foot-hills formations of northern Colorado was made preparatory to a revision of the geological map of the State. All these reports are excellent, though H. B. Patton's account of the Montezuma district concerns itself but little with the ore deposits—possibly because a short tale is soon told. However that may be, the account of the geology itself will be distinctly serviceable to any one undertaking development in this old district, which lies just over the range from Georgetown.

Tungsten. — The report on the tungsten deposits is of the largest general interest. Mr. George has wisely included not only a description of the local deposits, but some account of the occurrence and use of tungsten. From it we learn that the world's production, measured in 2000-lb. tons of concentrate containing 60% tungstic acid, amounts to a little less than 5800. Of this the United States ranks first with 1640, and Queensland second with 703. Portugal, the Argentine, and New South Wales follow with 702, 507, and 453 tons respectively. England is credited with 361. The Boulder county tungsten occurs mainly as ferberite. The deposits are remarkable for the almost complete absence of minerals commonly associated with tungsten.

General Progress.—The mining industry of Colorado jogs its contented way along. Just at present there is the usual rush at the coal mines, and the usual demand for cars for last-moment shipments, with the equally usual discovery that there are not enough cars to be had. Some way, though, everyone gets enough coal to keep going, and no one has yet frozen to death. The Roosevelt Tunnel at Cripple Creek pounds merrily along. In October the breast was advanced 380 ft., 3-shift work, making a total to November 1 of 11,400 ft. This is considered a good rate of progress for an adit driven with a single face in granite.

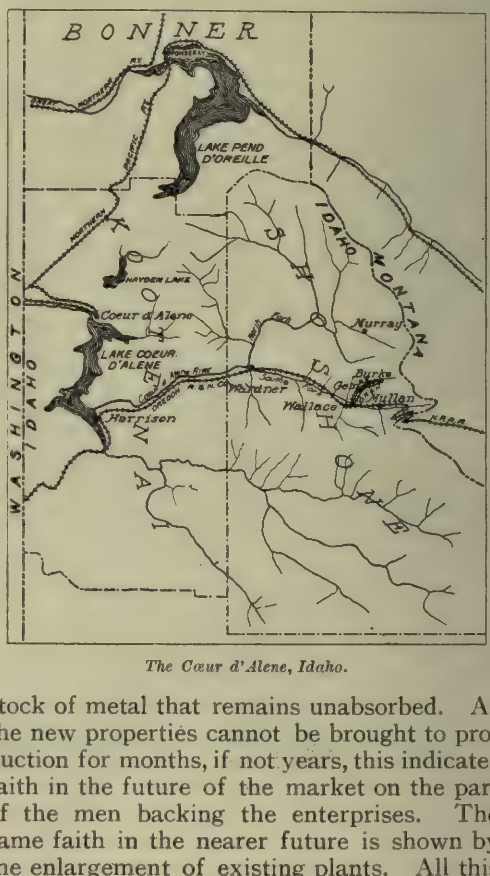
Lead Mines.—The threatened litigation in the Cœur d'Alene district has attracted an extraordinary array of legal and mining talent; success or bankruptcy ought surely to result. We are reminded of the reputed saying of the younger Mr. Clark when W. A. Clark was candidate for the United States Senate: "We will send him to the Senate or to the poor-house." It is said that at present a map of the apex rights in the Cœur d'Alene resembles a "diagram of searchlights from a fleet of battleships," and that before the case is finished it "will look like a pile of jack straws." Fortunately there is a bright as well as a dark side to the picture. The exploration undertaken in preparation for the suit is reported to be revealing great quantities of additional ore. This is especially welcome

Koreans crushing gold ore under rocking stones.

since, so far as present knowledge goes, this district and Missouri must be the source of any future large production of lead. The recent Conservation Commission listed only these States, Utah and Colorado, as seriously to be considered. Of Colorado the statement was made: "the State is rather thoroughly prospected, and the chance of new discoveries is correspondingly small," and of Utah: "there is little probability of a greatly increased output." In Missouri, on the other hand, it was found that "the supply will undoubtedly last for a great number of years, and it is undoubtedly true that there is a great extent of unprospected territory, with possibilities of ore deposits at a considerable depth," and of Idaho, "on the whole the prospects decidedly encourage the belief that the Cœur d'Alene district will be able to maintain or somewhat increase its present production for some twenty-five years at least." In general, the tone of the report was pessimistic. The discoveries in the Cœur d'Alene are therefore particularly gratifying. The report of the Bunker Hill & Sullivan Mining & Concentrating Co., recently published, shows that this company now has ore blocked for some years in advance. The reserves of the Federal Mining & Smelting Co., the other party to the litigation, are not known.

Zinc Mining.—The tariff on zinc ore has had the expected result. Prices of ore and spelter have both gone up. From June 1 to November 1 spelter advanced from 5·25 c., New York price, to 6·40. In the same period the basis for Joplin zinc ore rose from $43·50 per ton, 60% Zn, to $51. The smelters have, on the whole, lost ground, since the margin is now closer than ever. This they charge particularly to the Joplin mine-owners, and as a result every effort is being made to develop Western zinc districts. Not since 1905 has there been such demand for zinc ore in the West. At present Leadville, in Colorado, Park City in Utah, and certain New Mexican camps, furnish the major part of the output. Development is, however, active at other points in these States as well as in Arizona, Nevada, Idaho, and Montana. In Arizona the Golconda mine in Mohave county, the Savoy in Yavapai, and the Tombstone Consolidated have made important shipments, and still others are making preparations. At Good Springs, Nevada, where zinc has been known for many years, important orebodies have been recently developed, and at Butte, Montana, a new zinc-ore dressing plant is being erected. The Western States contain much zinc ore, but the bodies have been little mined and developed owing to the attraction of other forms of mining. While no such amounts of ore are immediately available as at Broken Hill, in the long run the Western United States is bound to be a serious factor in zinc production.

The copper situation continues to attract general attention. Development of the great new porphyry orebodies in the South-west goes on apace regardless of the heavy



The Cœur d'Alene, Idaho.

stock of metal that remains unabsorbed. As the new properties cannot be brought to production for months, if not years, this indicates faith in the future of the market on the part of the men backing the enterprises. The same faith in the nearer future is shown by the enlargement of existing plants. All this has given weight to persistent rumours that a great combine of American copper producers was in process of formation. At the time of writing it is said that plans are complete for the union of the Amalgamated, Cole-Ryan, Phelps-Dodge, and Guggenheim interests. It is impossible as yet to get official confirmation, but on the strength of the rumours copper stocks of all sorts have gone up. It seems clear that the men who are directing the big copper interests of the country would not be investing as they are unless they had some assurance as to the future. The importance of the proposed combination is evident.

MEXICO.

Political Outlook.—Politics in Mexico are on a perfectly normal footing once more, General Reyes has accepted a special commission to study compulsory military service in Europe, and there is no further opposition to the re-electionist party, therefore we may assume that Diaz will be re-elected President, and Corral vice-President, at the general elections next year.

Mining Enterprise.—Renewed activity in mining prevails throughout the Republic. A great number of new claims have been taken up on gold and gold-silver prospects in Oaxaca, and construction work on several large mills has either been started or projected. Several companies have been incorporated for the purpose of developing groups of mines or consolidations. In the Taviche district of Oaxaca two new American corporations will soon start operations under the title of the Eliseo Gold & Silver Mining Co. and the Two Brothers Mining Co. In Zacatecas, the Chalchihuites Company was incorporated, with Milton R. Straight as President, to operate an important group of mines in the district of the same name. A company has been incorporated in Zacatecas for the purpose of erecting and operating a custom mill; this company is considered of sufficient importance to receive the support of the State government, which has subscribed to one fifth of the stock. A Chicago company has been incorporated with a capital of $1,000,000 to take over the Centralia group of mines in the Hostotipaquillo district of Jalisco. With a view to operating mines in Tepic, McKeever Bros. of New York have incorporated the El Mirador Mining Co. with a capital of $2,500,000 to develop the Mirador and San Francisco mines.

Santa Gertrudis.—The business in connection with the sale of this mine, at Pachuca, is being watched with great interest. The option has half expired, but the prospective purchasers have no representatives at the mine and are doing practically nothing in the way of further examination. The price involved is a goodly sum, but then the owners of a proved and paying property are not likely to sell for less than the profits that they can see ahead. The prospects for future earnings will depend on the possibilities of unexplored ground at deeper levels, the concentration of a group of mines, and the installation of a modern and economical method of handling and treating the ore. A combination of the La Blanca, Santa Gertrudis, and Barron mines would have made an ideal group, but such a combination now seems to be impossible. The Santa Gertrudis ore is hauled over the tramway of an independent traction company to the Guadalupe mill situated at the lower end of the city of Pachuca, a distance of two miles. The Company is now erecting a new mill and cyanide plant on the *patio*, which, if it had been erected at the mine, would have saved the cost of transport. The La Blanca people are excavating a site for a mill, which will be erected in the near future; and the output of the Barron mine, which is owned by the Real del Monte Co., is carried by mule-wagons to

Tanateros or Mexican Ore-carriers.

the Loreto mill. These three mines are on extensions of the same vein, but owing to the contour of the country and the irregular location of the claims, at one point, the claims are one above the other on the hillside, and this gave rise to the statement that the La Blanca part of the vein dipped under the Santa Gertrudis. The general trend of the lode is east and west with a tendency to turn to the north at the east end. The vein crops on the south slope of the mountain and dips south. The vein forms a sheet conforming roughly to the general slope of the south face of the mountain. The extreme east end of the Santa Gertrudis claims picks up the vein below the La Blanca, so that at this point the bottom workings of La Blanca connect with the upper workings of Santa Gertrudis. The next section of La Blanca is immediately above Barron, and part of the Barron vein has workings that also connect with Santa Gertrudis; but eastward the Barron has a large extent of the vein, which could be worked at depth, following the dip south, without coming in contact with any other property. The Blanca eastern extension is also clear; only at great depth would it run under the south lines of Barron. The extension of this vein system to the east and south seems to offer opportunities for prospecting with diamond-drills, as there is no indication as yet that the veins pinch or impoverish at depth. In view of the great future possibilities of these three mines, it is much to be regretted that men of high professional and financial standing should have handled the options on two of these mines in such a manner as to lay themselves open to severe local criticism.

W. B. Merrill has resigned as managing director for the Real del Monte Co., at Pachuca, and is succeeded by C. W. Van Law, who recently has been consulting engineer for the Guggenheims, and previously was general manager for the Guanajuato Reduction & Mines Co. In regard to the open bids for Pachuca tanks made by manufacturers without license from the patentees, it is now stated that the Cia. Beneficiadora de San Francisco has discarded these bids, and has placed the order for three additional tanks with the owners of the patents themselves, namely, Grothe & Carter of Mexico City. Two other orders have also been placed, notwithstanding competing bids. This looks as if the mining companies would rather pay royalties than run the risk of litigation.

MELBOURNE.

Mount Balfour. — The most important mining event in Australia for the past month has been the development of the Mount Balfour copper district, in Tasmania. This is an old mining centre; twelve years ago prospectors forced their way thither from Zeehan and were rewarded by finding a limited quantity of tin in some of the gullies off the Norfolk range. Later a couple of prospectors held a big block of ground near the deserted Mt. Balfour township. One of them has disappeared and cannot be heard of, though a fortune awaits him; the other is said to have transferred his interest to two brothers named Murray. These were scratching for tin when they alighted on copper ore. Now they are opening a vein of rich oxide, copper glance, and some high-grade chalcopyrite. Hearing of the discovery, the Mt. Lyell company sent out prospectors. These working inland from the north coast of Tasmania found signs of ore, which they traced for several miles along the course of the range toward Mt. Balfour. The company has now pegged out a parallel line of leases about seven miles in length toward Mt. Balfour. North of, and adjoining, Murray's lease lie a series of blocks acquired by Messrs. Knox, Bowes Kelly, Jamieson and other leaders in the Mt. Lyell enterprises. This block is said to be developing well. Robert C. Sticht, general manager of the Mt. Lyell mine, is interested in this property and it is said that he has privately expressed his satisfaction at the way in which the claim is being opened up. Mr. Sticht has been spending a fortnight in the district to investigate the value of the properties pegged out on behalf of the Mt. Lyell company. This district is almost inaccessible; there is no decent harbour anywhere near. Therefore development will be slow unless the Mt. Lyell company decides to take a serious hand in providing facilities for treating the ore. At present all that can be said is that the ore is found under barren quartz outcrops over a considerable distance. But the geological features of the district are not yet determined, nor has the ore been followed to any depth. Therefore the most that can still be said is that the district is full of possibilities. A geological examination will be made for the Government at an early date. Meanwhile, Mt. Balfour has afforded ammunition to company promoters in Melbourne.

North Queensland mines are suffering from lack of working capital. Of these the most important is Mt. Cuthbert Copper. This lies somewhat out of the reach of railways, but should the Queensland government, as is contemplated, carry a line to the northwest boundary of the State, this mine will be well served by it. The delay is annoying, for the company has done well in opening up fine bodies of copper ore so far as sinking has gone. The depth certainly is not great but the extent of the formation shows that the company ought to be furnished with capital to sink and prove what is below. The fact is, the Queensland directors are afraid of calls and also seem to be chary about underwriting. The possibility will be that, instead of a new issue of shares being created with a defined liability, a reconstruction will be attempted under the no-liability system. This permits holders to drop out whenever they choose. The fate of the mine therefore may be jeopardized through the inability of some shareholders to look at the business in a big way. London investors are involved.

Processes.—Important experiments have been conducted by E. J. Horwood, manager of the reduction works of the Broken Hill Proprietary Co., with a process that he has patented for the treatment of complex ores. The idea is to separate zinc-blende from other sulphides when slimed. The experiments have been conducted on one-ton lots at the Bendigo School of Mines and under absolute working conditions. The ores tested are from Broken Hill and Tasmania (the Hercules and Mt. Read mines). The latter so far have been handled without commercial success by many experimenters. Mr. Horwood claims "to sulphatize or oxidize the sulphates other than zinc, by roasting at a low temperature or by treatment in the wet way by means of chemicals, though roasting is preferred. After thus 'deadening' the other sulphides the zinc can be easily floated by the use of acid, oil, and agitation, leaving the residue containing the lead and the major portion of the other metal contents as a good smelting material. In the case of Broken Hill slimes a zinc concentrate containing over 50% zinc and a lead residue of 50% are obtained with recoveries of each metal on the respective concentrate of over 80%. In the case of the Tasmanian complex sulphides a zinc concentrate of very high-grade (about 60%) is obtained with recoveries of over 80% as in the case of Broken Hill slimes." These facts have been communicated by Mr. Horwood, who, from his official position on the Broken Hill Proprietary Co., is not likely to speak with uncertain voice. The work is of the utmost interest. The point seems to be how to obtain the exact roast. As every ore presents variations it will be of importance to see how the patent works on a big scale. What is shown is how one process is linked with another. First came the Potter acid flotation; this was crude and undeveloped, but the worthy germ of a great idea. Next, the Delprat. Then these seemed to merge with the Elmore. The Minerals Separation followed; then the De Bavay, and now the Horwood. To retrace a little, it should be remembered that the dry magnetic-separation process led Olding and Jamieson to experiment with a wet magnetic separator. Jamieson found that a slight roast increased or decreased the response of the mineral particles to magnetism; this idea seems to have been adopted by the Zinc Corporation and now has been extended by Horwood.

Central Mine, Broken Hill.

Cathcart.—The Englishmen who formerly held some 36,000 shares in the Cathcart gold mine, at Ararat, must feel chagrined. Over 1400 ft. of a rich run of gold has been proved on the north side of the deep lead. Some of this wash yields an ounce of gold to the truck, most of the gold being exceedingly nuggetty—indeed a 45 oz. slug was picked out of the dirt the other day. This means that the gold has not travelled far. The market in Melbourne has run riot over the richness of the wash and consequently Cathcart shares have advanced to £6½, so that the 36,000 shares forfeited or sold by the English investors in the property represents a tidy loss. The mine is on a tributary of the Langi Logan lead into which converged all the rich gutters worked in the old days. The success of the Cathcart has enabled capital to be raised to open up and test Langi Logan gutter. It may be unwise to predict, but as the shallow alluvial round Ararat was remarkably rich it will be astonishing if the Langi Logan lead does not give some bonanza ground. That property was also in British hands, but was abandoned without a pick being put into the ground. The collapse of the 'deep lead' industry and the failure of the work done at Cathcart to come up to expectations, of course, accounted for the ground being abandoned.

TORONTO.

La Rose.— The most interesting recent event has been the further decline of La Rose stock to about par ($5) consequent upon the publication of a statement by the president, D. Lorne McGibbon, and a party of the Montreal directors after an inspection of the various properties owned by the company, coupled with the announcement that the dividend would be reduced from 16 to 8% per annum. The reasons for this action are fully set forth. The directors found that the only property that had been well developed was the original La Rose claim of 40 acres, which had been supplying practically all the funds to pay dividends and develop the other prospects. They were surprised to find that so little money had been spent on the latter and came to the conclusion that La Rose proper could not be expected to supply indefinitely the money necessary to pay dividends at the present rate and bring the other properties to the productive stage, and therefore decided on the conservative policy of putting aside a largely increased amount for development work, increasing the cash resources and the company's ore reserves. The most startling announcement, however, was made in reference to the Lawson claim, which, owing to the richness of the discoveries on the surface, had been regarded as certain to furnish a considerable proportion of the company's high-grade output. The delay in its development is largely attributable to the failure of the Cobalt Hydraulic Power Co. to furnish compressed air, which was promised on July 1, but it is not now expected before January. Sinking and driving at a depth of 88 ft. on the main vein has proved extremely disappointing, as at that depth the output is only low-grade ore. This was the first intimation of the fact to the public and was probably more influential than the reduction of the dividend in causing a sudden drop in the quotation from $6·55 to $4·75. The revelation has affected the entire Cobalt list, and the market has remained depressed ever since. The policy now adopted by the re-organized directorate is heartily approved by the general manager, R. B. Watson, who is understood to have been strongly opposed to the course pursued by the New York interests lately in control, of exhausting the ore reserves to make a big showing of shipments so as to influence the market.

Statistics.—The eighteenth annual report of the Ontario Bureau of Mines for 1909 by T.W. Gibson, Deputy Minister of Mines, gives the revised figures of the mineral output of the province for 1908, which were somewhat under-stated in the preliminary statistics furnished early in the year, at $16,754,986 metallic, and $8,882,631 non-metallic, a total of $25,637,617 as compared with $25,019,373 in 1907. The largest item is silver, 19,444,400 oz. valued at $9,136,830. The report refers to the great discrepancy in the valuation of the mineral output as between the Canadian Geological Survey and the Mining Department of the Provinces. It cites a particularly glaring instance in the Survey's preliminary report for 1908, where the value of the nickel, which all comes from Ontario, is placed at $8,231,583, the Ontario Bureau's valuation being only $1,866,059. The basis of valuation in the two cases is entirely different, the Survey valuing the nickel in the matte produced at the Sudbury furnaces at the average price of refined nickel in New York, while the Bureau's figures represent the value of the nickel in the form of matte at the point of production. Mr. Gibson doubts the propriety of including transportation charges and the cost of the various processes to which the nickel and matte are subjected before the refined metal is obtained, as part of the value of the nickel as it leaves Canada in the form of matte. The need of a uniform system of compiling these statistics has long been felt. The Bureau has attempted to ascertain the entire yield of silver in Ontario up to the end of 1908. Official figures for the earlier years of silver production, beginning with 1870, were not obtainable, but an estimate from data obtained from various authorities gives the total production previous to the opening of the Cobalt mines in 1904 at 4,748,541 oz. of the value of $5,135,681, while the subsequent official figures show an output to the end of 1908 of 37,586,970 oz. valued at $20,468,751, making a total production of 42,335,511 oz. valued at $25,604,432.

Gillies Limit.—The figures showing the value of the ore shipped from the Provincial mine on the Gillies limit, during the period of its operation by the Government are given for the first time, and are not calculated to encourage extravagant expectations as to the value of this area. Three shipments of ore were made during the season of 1908, the last being July, when shipping was discontinued, but no information as to the value of the consignments was published. Meanwhile the mine and a considerable acreage in the neighbourhood has been sold, and now the facts are given as follows: The first two shipments of

42,028 and 50,075 lb., were of cobalt ore without silver contents and realized $1,188 and $2,101 respectively; the third shipment of 48,625 lb. was of low-grade silver ore, assaying 738 oz. silver per ton; and this, with other metallic contents, realized $9,027. It is safe to say that had these details been generally known when the Gillies Limit sales were taking place the prices obtained would have been considerably smaller, though it must not be forgotten that some at least of the properties show rich outcrops. One of these, the Waldman, is likely to be an early shipper and great progress has been made in equipment and development. Over 100 acres of this property have been cleared, buildings erected, and the shaft put down 75 ft. in addition to doing several thousand feet of trenching. [Later.] The fourth sale of land on the Gillies Limit took place on November 16, when 37 out of the 55 lots offered by the Ontario government realized an aggregate of $372,462, which is an average of $482 per acre. The richness of the Waldman mine stimulated the bidding.

Part of Canada.

CAMBORNE.

Alluvial Tin.—Last month a syndicate was formed to work the Red Moor alluvial deposits. These placers are situated about two miles north of Lostwithiel and about an equal distance south of Lanhydrock House. This is probably the only alluvial deposit in the county of Cornwall that has not been worked by the Phœnicians, Romans, Jews, or by the 'old men' who date anywhere from 50 to 1500 years ago. The area that is now proposed to be worked by dredging is over 200 acres, and has been well prospected and tested with drill-holes. The average of the samples has been about four pounds of tin to the yard. It is stated that 95% of the tin can be saved. The men at the head of the syndicate are experienced dredge-men from Victoria, Australia, and have been fortunate in making the dredging in that State pay well. Lord Clifden, the owner of the land, with his usual generosity, has consented to take 2½% of the gross proceeds, which is equal to dues of one fortieth irrespective of the price of tin.

Goss and Tregoss.—In my notes in the October number of this Magazine reference was made to the fact that an Australian syndicate had drilled a hundred 3-in. augur-holes. Since then 50 more holes have been drilled, the average depth of the whole number being 22 ft. The assays of the material obtained from these holes demonstrate the ground to contain 1½ lb. black tin per cubic yard, worth one shilling, with black tin at £80 per ton. The property, which is over 500 acres in extent, is being worked by Goss Moor Limited, with a capital of £60,000. The leading spirits in the enterprise are G. C. Lush and T. L. Field, both alluvial experts, while J. H. Collins, who started the operations with a small Cornish syndicate is on the Board. A pump is now at work pumping the water from one of the pools in order to build a dredge or pontoon. All the timber for the work has been delivered and is being prepared. Two new 250 hp. Crossley gas-engines have been ordered. The dredge now being built will have to support a weight of over 120 tons, and should be at work early in the new year. The working of a 4-in. nozzle directed against a bank 20 ft. high will be a new sight in Cornwall, and will be watched with much interest by mining men, investors, speculators, and the general public. This stream has been repeatedly washed and all the 'prill' or coarse tin has been sold. Since October there has been a demand for alluvial properties throughout

Cornwall, and early in the new year there seems a probability that many companies will be floated, on the strength of what is being done at Red Moor and Goss & Tregoss. Applications have been made for almost all the alluvial deposits. Perhaps other districts will be found carrying pay-gravel if worked by experienced managers and skilled 'pipers.'

Carn Brea & Tincroft.—Prospects here are improving. At the last ticketing 40½ tons of tin were sold for nearly £3000. Development work seems to be well ahead, and the bottom of the mine yields richer ore; there is also a decided improvement at the 170-fm. level in the North Tincroft section. The alterations at surface, although not expensive, tend to economy and efficiency, especially the new hoisting-engine now being erected at Willoughby's shaft. The eighth calciner has recently started to work, as more arsenical ore is being treated than before, and the price of arsenic steadily improves. Altogether the prospects are decidedly better; there is a demand for the shares, and it is hoped that the year 1910 will see this old group of mines again on the dividend list.

South Crofty.—Eighty 'dead' frames, two revolving frames, and other machinery erected by a 'tin streamer' have just begun to work, and the streamer seems confident of a good return for his outlay. The tribute or toll paid to the mine is 4s. in the pound, equal to a royalty of 20% or dues of one fifth. The 'dressing plant' has been erected on the South Crofty sett, the object being to catch the slime before it is discharged into the Red River. This method of 'tributing' is a good check on the mine; if no tin escapes the streamer has lost his capital and time; but if he continues to work, it will be known that he gets some tin, and the mine from which the tin escapes is spotted. The discovery at the 160-fm. level, made two months ago, still holds good; a mill-test showed a recovery of 50 lb. of tin and wolfram per ton. As soon as this lode is opened up by means of other drifts it will prove a valuable asset.

Wheal Gorland, St. Day.—This mine is worked as a private concern by Edgar Allen & Co., of Sheffield. The property has been unwatered to the 80-fm. level, that is, 20 fathoms below the adit. A 7-in. Cornish pump driven by a horizontal engine handles the water easily. When the mine was last worked for copper ore, the lode was stoped for a width of 12 inches, and now that it is worked for tin and wolfram—for not a ton of copper has been sold—the sides of the lode are blasted to a width of from 6 to 10 ft., so that the mine is easily worked, and it needs to be, as the tin averages less than 20 lb. per ton. There is a marked resemblance to the ore raised here and the ore from the East Pool mine, which is situated fully four miles westward. In that four miles the lode, if the same, has been disturbed many times by the action of elvan dikes and cross-courses. The ore is carried to the Poldice mill, and crushed by means of stamps and ball-mills, and is subsequently treated in a magnetic machine to separate the wolfram from the tin.

Parbola mine now gives employment to 80 men, and has just sold its second parcel of tin—4¼ tons. The manager is hopeful that from the development at the bottom of the mine, 40 fathoms, the property will be self-supporting.

Levant.—Cornishmen in every part of the world will be sorry to hear of the death of Major White, who for 59 years was officially connected with this mine, first as a clerk in 1850, then purser, and manager since 1870. He was the last of the old type of mine captains who dispensed hospitality with no niggardly hand, and not simply on 'account days,' St. Aubyn's days, and 'pay-days.' The Major will long be remembered for his devotion to Levant. Freethey Oats, son of Captain Frank Oats, president of the De Beers Consolidated, presided at the meeting held on November 23, when the accounts presented for the previous four months showed a loss of £944, and a call of 5s. per share was made to cover part of this adverse balance, the rest being carried forward in view of the improved appearance of the mine and a likelihood of a profit at the next account. The expenditure for the 16 weeks was £12,500 and the receipts £11,566, being 33s. and 30s. per ton crushed respectively.

Geevor mine is also in the St. Just district. The property is cheaply worked, as operations are confined to above the adit. The sales vary from 7 to 10 tons of tin per month. A new vertical shaft is being sunk to intersect the veins on the underlie. The ore is treated in a 10-stamp mill well equipped with the usual concentrating plant. A new crusher has recently been placed near the shaft.

West Kitty.—Rumours are rife that this mine is to be taken over by a group of financiers well known in Cornwall, but so far nothing has been communicated to the share-holders. Nicholas Trestrail has resigned as engineer.

GOLD MINING IN FRANCE

By JAMES A. RICKARD

FIVE gold mines in France are working at a profit:

(1) **Mine de la Lucette,** Mayenne. This mine employed 532 workmen in 1907 and produced 13,580 oz. of gold from 45,000 tons of antimonial ore. About one half of the gold, namely, that in the quartz, was saved by amalgamation: the other half was caught in the slags of the antimony furnaces and was sold to German and English smelters.

Puits St. Jean, Villaniere.

(2) **Mines de la Belliere,** St. Pierre Montlimart, Maine-et-Loire. This also seems to be a successful affair, shares being quoted at five to six times their par value. This company was organized in April 1905 with a capital of 4,000,000 francs (or £160,000), in 40,000 shares of 100 francs each. Mining operations extend to a depth of 80 metres and the lode is said to vary in width from 6 to 19 metres, with an average of 10 metres. The production was 101 kilograms of gold in September; in August, it was 96 kilo.; in April, 63; and in January, 47 kilo. A steady increase is apparent. In 1908 the total yield of gold was 532 kilo. 396 gm., equivalent to 17,174 ounces. The profit for the year was 644,693 francs; this year the profit will be about 2,000,000 francs or £80,000. Current production is about 3000 oz. per month. It is claimed that the reserves of ore amount to 250,000 tons. The ore is auriferous mispickel. In 1907, 45,294 tons was stamped, tube-milled, and concentrated; the concentrate being then roasted and cyanided. An Elmore plant was put up two or three years ago, but it is not being used. This mine employs 322 workmen.

(3) **Mines du Chatelet,** Creuse. This mine is also paying dividends but no details of capitalization are available. The gold is finely disseminated in quartz and kaolinized gangue

Sorting Ore at the Salsigne mine.

carrying 3 to 4% iron pyrite and 2% mispickel. The treatment is by roasting and cyanidation after the Kalgoorlie type, including the use of ball-mills, Merton furnaces, tube-mills, agitators, and vacuum-filters. An extraction of 85% is made, according to W. E. Simpson.

(4) **Mines de Salsigne,** Aude. From this mine more than 12,000 tons of 1 oz. ore have been shipped in one year to Swansea smelters. The ore is a mixture of quartz, pyrite, and mispickel, usually somewhat oxidized. About a year ago this company secured the services of J. H. Clutton, an English metallurgist, who erected a smelter; the mine is now treating ½ oz. stuff at a good profit. The rich matte is sold to Elliotts at Swansea.

(5) **Mines de Villaniere** Société des Mines de l'Aude. This is contiguous to the mine last mentioned. Several lodes are being exploited. The ore is chiefly mispickel and pyrite, containing the precious metals. Owing to the present low price of arsenic, work is mostly confined to the rich gold ore (from 1 oz. upward) of Terrisse and Ramelles; this is shipped to Swansea. The Terrisse and Roc Soufrat deposits are in limestone and are probably Devonian. The Narteau is a contact between limestone and schist. Camazou and Ramelles are in a schist formation (probably Silurian). All the ores except those of Terrisse contain a little silver, 3 to 8 oz. The Ramelle ore also contains copper, about 1%. The ore is sold to smelters at the rate of 5000 to 6000 tons yearly, its content of gold averaging 1 oz. or better. Some lots of oxidized ore have assayed as much as 4 oz. per ton. A concentration plant having a capacity of 50 tons per day is being erected and it is likely that a smelter (for pyritic smelting) will be added, yielding copper matte and arsenious acid.

Gold Mining in Wales.—During the past summer the Ogofau gold mines, supposed to have been worked by the Romans, have been re-opened. The mines are situated in Carmarthenshire about half-way between Llandovery and Lampeter. There is no doubt about there having been a Roman camp adjoining the mines and the surmise that this camp was built for the accommodation and protection of miners is a legitimate one. The old workings were in the nature of quarries and it is supposed that only oxidized ore was worked. There are remains also of an old Roman aqueduct following the contour between 700 ft. and 800 ft., and it is supposed that this water was used among other things for washing the ore. The quarries are from 80 to 100 ft. deep and an estimate shows that the amount of rock extracted was something like 4,000,000 tons. At the present time exploration is being conducted by means of drifts and shafts, and quartz containing pyrite and arseno-pyrite with an average of 11 dwt. of gold is being encountered. A 5-stamp battery and a Wilfley table have been erected. This work is being done by the Cothy Mines Limited and James Mitchell is the engineer.

A new monthly periodical called 'Industrial Progress' is being published by and in the interests of the Allis-Chalmers Co. The contents consist of articles written by specialists on plants erected or processes employed by the company, some of them specially prepared for this paper and others reproduced from independent journals. The articles are not flaring or prejudiced puffs of the firm's goods, but fair and dispassionate accounts of what the company can do in every-day practice. Knowing the source of the periodical and understanding the reasonable methods employed, the reader will find the information of value.

Port Kembla Copper Works.—The copper smelting and refining works at Port Kembla, 50 miles south of Sydney, N.S.W., belonging to the Electrolytic Smelting & Refining Co. of Australia, commenced operations in February last. The company has the contract for the refining of the blister copper produced at Mount Morgan, the amount at present being over 5000 tons per year, with a prospect of a steady increase. In addition to this work the company conducts a general custom business in copper ores and mattes. The smelting department contains reverberatories each having a capacity of 60 tons per day, and measuring 35 by 18 ft. Chrome iron ore is used for lining them. There are two converters of the barrel type, 10 ft. 6 in. long by 7 ft. 6 in. diam., and each is capable of producing 25 tons of blister copper per day. The electrolytic refinery contains 360 vats each measuring 10 ft. by 3 ft. 6 in. by 3 ft. and the capacity is 35 tons of copper per day. The gold and silver recovered from the slime are parted electrolytically. Electric power is used throughout the works and is generated by steam. Kilker tipping moulds are used for casting the anodes, the first time that this machine has been introduced into Australia. According to the *Australian Mining & Engineering Review* the average assay of the anodes at present produced is 99·4% copper, 10 to 20 oz. silver, 12 to 15 oz. gold, and the cathodes produced assay 99·85% copper. After refining the copper is cast into wire-bars assaying 99·96% copper.

INVESTMENTS AND SPECULATIONS II.

By A PROFESSIONAL SPECULATOR.

I HAVE read with much interest the discussion and criticisms of my contribution to your September number. To clear up some misapprehension, I may say that my objects in offering this list for publication were :

1. To warn serious people of the risk they are taking in purchasing or holding certain mining shares.

2. To demonstrate that investment in mines can be as legitimate and sound as any other form of industrial enterprise, if properly advised.

3. To show that every mining engineer can become a successful exploration company on his own account.

The proof of a pudding is in the eating, and although I stated that the business under discussion is based primarily on the relation between the intrinsic merits of the undertaking and the share quotation, and that it takes time for these two factors to adjust themselves, it is still worth while to ask my critics to note the results accruing during the three months that have elapsed since my tabulated statement appeared. The past three months have been a period of political and monetary slumps of unusual violence. In such times most speculators are satisfied if they make no losses. If we take middle prices at the date of my last list and again today (December 5) and assume that as nearly as may be £5000 was invested on mines in each column, in equal amounts for each company, the results would be as follows :

Class.	Invested.	Appreciation.	Depreciation.
Excellent	£5,000	£78. 5 0	
Fair	£5,000		£350. 2 6
Moderate	£5,000		£496. 18 0
Indifferent	£5,000		£574. 10 0

I have not bothered to calculate the 'Remote' column.

As to my critics, I thank Mr. Worpledon for his endorsement. Also I appreciate Professor Moriarty's point of view. We have no common ground. His business is based on the yield from human credulity ; mine upon participating in the profits of realizing minerals into metal. He would succeed equally well as a 'bookie' or running a yellow journal. The Stock Exchange is paved with would-be Moriarties.

Last September I stated that the classification is no fixture, but alters from day to day through extension of development, rise or fall in quotations, change of management, or condition of the metal market. I append the table as it stands today, and I desire to emphasize the fact that this tabulation does not refer to conditions as they were a week ago or as they will be next week. I have neither the time nor the inclination to state my reasons for individual changes. For the benefit of those (including some critics) who have not read the basis of this classification, I repeat it herewith :

I. **"Excellent."** — The management, proved value, and speculative chances are such that, compared with the price, no engineer would hesitate to recommend the purchase of the whole mine at its market value. It is considered that an investment spread over this list is certain of ultimate profit.

II. **"Fair."**—The proved value is less, but the speculative possibilities are very good, that is, the mines are good in the bottom workings or the company has other assets with sound prospects. This class is kept under close surveillance as the members of it may at any time advance to Class I. either by fall in price or improvement in outlook. An investment spread over this list is considered to be without risk of ultimate loss and possesses a speculative chance of profit.

III. **"Moderate."**—These are concerns with less proved merit but fairly good speculative chances. The chance of loss in this list is considerable. Fortuitous circumstances often provide large profits, but these enterprises are highly speculative at the price of today.

IV. **"Indifferent."** — These are shares that have some value, but they exhibit a great gap between price and merit. These are not likely to come into Class I. except by the most astonishing chance of fortune ; as an investment they rank with roulette.

V. **"Remote."**—These, as an investment, rank with the Honduras State Lottery.

[The tabulated list will be found on the two pages following. We would have liked to disclose the identity of our contributor, but his reason for anonymity is obvious.—EDITOR.]

GOLD SHARES. AUSTRALIA.

I. Excellent.	II. Fair.	III. Moderate.	IV. Indifferent.	V. Remote.
Mount Morgan	Kalgurli	Great Boulder	Boulder Perseverance	Central and W. Boulder
Ivanhoe	Sons of Gwalia	Associated	Great Fingall	Cosmopolitan
Horseshoe	Waihi	Associated Northern	Hainault	Gt. Boulder M. Reef
Lake View	Golden Links	Chaffers	Northern Mines	Northern Territories
Oroya Brownhill		Gwalia Consols	Mt. Boppy	Myalls and Peak Hill
Hannan's Star		Oroya Black Range	N. White Feather	Gwalia Proprietary
		Lancefield	Sth. Kalgurli	Orion
		Con. Goldfields of N.Z.	Tasmania Gold	Berry United
		Blackwater	Mills Day Dawn	Brilliant
		Waihi Grand Junction	Progress Mines	Day Dawn Block
			Talisman	Queen's Cross
				Gold Reefs Exploration
				Victory(Charters Towers)

GOLD SHARES. WEST AFRICA.

I. Excellent.	II. Fair.	III. Moderate.	IV. Indifferent.	V. Remote.
Cinnamon Bippo	Abbontiakoon	Champion Reefs	Tarkwa Main Reef	North Tarkwa
Prestea Block A	Abosso	Appantoo	Ashanti G. C. United	Offin River
	Ashanti Goldfields	Bibiani	Sansu	West Africa Development
	Fanti Consolidated	Effuenta	Wassau Central	Obuassi Syndicate
	Gold Coast Amalgamated	Himan	Wassau West	Tarkwa Banket West
	Prestea Mines	Wassau	Broomassie	
	Tarkwa Explorations		Tarkwa & Ashanti	
	Fanti Mines		Axim & Tarkwa G.F.	
	United Exploration		Cobra Banket	
			Kings Treasury	

GOLD AND SILVER. AMERICAN.

I. Excellent.	II. Fair.	III. Moderate.	IV. Indifferent.	V. Remote.
	Mexico Mines of El Oro	Camp Bird	Hudsons Con.	Carmen Mines of Mexico
	Alaska Mexican	El Oro	Barranca	Le Roi
	Alaska Treadwell	Esperanza	Brazilian Goldfields	Great Bonanza
	Alaska United	Tomboy	B.C. Smelting	Stratton's Independence
	Oroville Dredging	Exploration Co.	Kerr Lake	Van Roi
	La Rose		Le Roi No. 2	Ymir
			Peru Mines & Estates	Austin-Manhattan
			St. John del Rey	
			Tominil	
			Providencia	

Gold Shares. Rhodesia.

	Eldorado Banket	Antelope	Chartered Trust	New Rhod. Mines
	Enterprise	Globe & Phœnix	Chicago Gaika	London & Rhodesia Mining
	Rhodesia Banket	Mayo Devlopment	Bechuanaland Exploration	London Wall Trust
	Giant Mines	Rhodesia Exploration	Gaika Gold	Matabele Central Estates
			Jumbo	Selukwe
			Selukwe Columbia	Surprise
			Amalg. Prop. Rhod.	Wanderer
			Bucks Reef	Rhodesian Consolidated
			Bulawayo & Genl. Exp.	Etna Development
				Mashonaland Con.

Lead, Silver, and Zinc.

Broken Hill North	Broken Hill Block 10	Block 14 Pref.	Broken Hill Proprietary	Linares
Zinc Corporation, Pref.	Zinc Corporation Ord.		B. H. Block 14, Ord.	British Broken Hill
Sulphide Corp., Pref.	Brcken Hill South		San Francisco Del Oro	Murex Magnetic
Amalg. Zinc	Sulphide Corp., Ord.		Weardale	Palmarejo
	Broken Hill South Block		B. H. Junction North	Frontino & Bolivia

Copper Shares.

Great Cobar	Tennessee Copper	Utah Copper	Amalgamated	Chillagoe
Miami	Arizona Pref.	Utah Con.	Anaconda	Corona Queen
Mt. Elliott	Spassky	Esperanza	Cape Copper	Mt. Lyell Comstock
Ray Consolidated	Mt. Lyell	Huelva	Famatina	Mt. Lyell Consols
Great Fitzroy		Mason and Barry	Libiola	Mt. Molloy
Chino		Otavi	McGregor Cloncurry	Mungana
		Nevada Consolidated	Messina	Nevada-Utah
		Rio Tinto	Namaqua	Phillips River
		Tharsis	New Einasleigh	Queensland Exploration
		Gila	Oonah	Union Consolidated
		Ray Central	Tanganyika	Utah Bingham
		Boston		Utah Apex
				Whim Well
				Widin

Miscellaneous.

	Lena Goldfields	Champion Reef	Siberian Prop.	Nile Valley
	Russian Mining	Ooregum	Orsk Goldfields	
	Mysore	Nundydroog	Troitzk Goldfields	

December 5, 1909.

METAL MARKETS

COPPER.

The month began with a continuance of the rumours as to a consolidation of producers' interests in the United States. Reports as to this intention were denied by the interested parties, as freely as they were circulated, until toward the middle of November, when official reticence was cast aside and it was admitted that considerable progress had been made in uniting the powerful and hostile interests of the Cole-Ryan, Amalgamated, and Guggenheim groups under the aegis of the Morgans. It was proposed to impose a self-denying ordinance reducing the production of the leading mines. The swelling stocks here, which had depressed the market at the beginning of the month, were soon forgotten; the Metal Exchange witnessed enormous transactions in standard copper, and the three months' price, which ruled at £58. 3s. 9d. at the beginning of the month, had reached £62 by the 20th. It is not a little remarkable that on two Saturdays in succession, namely, the 20th and 27th, the market has received severe shocks from unexpected quarters. The decision of the Court of Appeals against the Standard Oil Co. produced severe liquidation, and even demoralization, which was only arrested by heavy supporting orders from America, and confidence was scarcely restored when a Boston attack upon copper shares, accompanied by reports as to a contemplated Government prosecution of trusts in general, and the illegality of the copper merger in particular, plunged it once more into a state of feverish nervousness. The vulnerability of the market, when the position is seriously menaced, was shown by an immediate slump to £58. 15s., at which three-months copper was at one time done. The month closed with a firm tendency.

The demand for consumers has been on a wholly satisfactory scale; until the slump in prices, purchases were heavy and producers were reported as withdrawn from the market for earlier dates, and unwilling to quote for more distant delivery. Trade is active in most branches, and although complaints are common in the electrical industry, it also continues to absorb respectable quantities. Consumers in America have bought largely, and are reported as highly optimistic as to the future. Europe has purchased large lines from American producers, and would have taken more had not the latter raised their selling price. The closing of some of the mines at Butte, the outbreak of a strike of railway workers, and the near approach of a time of year when transit may be difficult, have no doubt rung a warning as to further sales.

Average price of cash copper:

November 1909.	October 1909.	November 1908.
£58. 19s. 4d.	£57. 13s. 1d.	£63. 10s. 8d.

TIN.

This market was taken by surprise by the favourable statistics for October but it was not until the middle of the last month that their full effect was realized, when the expansion of the American demand lead to the closing of bear accounts. The end of the month shows continued activity in the demand and in spite of an increase in stocks the market remains strong in prices showing a rise for the month of about £5. The strong American position in the iron and steel trades gives rise to hopes of further increase in consumption of the metal there.

Average prices of cash tin:

November 1909.	October 1909.	November 1908.
£140. 0s. 3d.	£138. 13s. 3d.	£137. 8s. 3d.

LEAD.

In this market seasonal demand plays a more important part than in other metals. The market, which looked strong at the end of October, was allowed to drift into a condition of lifelessness until it was aroused from its lethargy by the prospects of its Australian supplies being cut off and a consequent demand from China and Japan. Home consumers, however, find no demand and although supplies are diminishing in quantity no strong buying movement has developed. Stocks in the hands of consumers are believed to be small and the considerable speculative interest has carried the position forward for three months.

Average prices of soft foreign lead:

November 1909.	October 1909.	November 1908.
£13. 1s. 4·70d.	£13. 4s. 4¼d.	£13. 12s. 1⅝d.

SPELTER.

Business has been quiet and uneventful. The demand is steady and both the brass and galvanizing trades are well employed. The approach of winter, when frost usually interferes with the transport of supplies from the interior of Germany, may, as it has done in the past, cause considerable anxiety as to stocks.

Average prices of good ordinary spelter:

November 1909.	October 1909.	November 1908.
£22. 2s. 1·22d.	£23. 3s. 4d.	£20. 17s. 1d.

FLOTATION PATENTS

THE House of Lords delivered its considered judgment on November 16 in the appeal of the Minerals Separation Ltd. *v.* the British Ore Concentration Syndicate Ltd. and A. Stanley Elmore. The Court consisting of five members unanimously allowed the appeal, ruling that the process of the Minerals Separation did not infringe the Elmore patent of 1901.

This dispute was between the owners of the Elmore patents of 1898 and 1901 and the owners of the Sulman-Picard-Ballot patent of 1905. The 1898 patent described the method of using heavy oil to float off the mineral from a flowing pulp, and the 1901 patent was a sort of addendum to this, claiming the use of a small quantity of acid for increasing the affinity of the oil for the mineral. This second patent was primarily intended to refer to the process described in the 1898 patent, but the patentee did not restrict his invention to this special application. In fact, the argument in the lawsuit was that the patent covered the application of acid to any oil process. The question at issue before the House of Lords was whether the 1901 patent covered the use of acid in any mixture of oil, ore, and water, whatever the proportional amounts of each and whatever the nature of the oil, gas or air bubbles being used in addition or not. In the 1905 patent of Sulman, Picard, and Ballot the claim is for the use of small quantities of thin oil and acid to catch the mineral, and the flotation is effected by means of gas or air bubbles or froth. The judgment of the House was that the 1905 patent did not infringe the 1901 patent. The reasons for arriving at this conclusion were given in the judgments read by the Lord Chancellor (Lord Loreburn), Lord Halsbury, Lord Atkinson, and Lord Shaw. Lord Ashbourne did not read a separate judgment, but expressed his concurrence with the Lord Chancellor and Lord Halsbury.

The Lord Chancellor's view was that the application of acid was not sufficiently exactly defined in the 1901 patent; in other words that the patent claimed the use of acid in any quantity with any sort of mixture of oil, water, and ore, though "generally and preferably" it was stated that the application would be the addition of a small proportion of acid to a freely flowing pulp containing substantial amounts of oil and water. His lordship considered that the framing of the specification had been arranged in such a way that it could be applied either to the general application of acid or to the specific method actually recommended and described in the 1898 patent. To his mind the patent thus became too indefinite, and he considered this method of drawing up a specification to be a faulty one. In dealing with the claim for the general application of acid his lordship quoted the Everson patent of 1886, in which the use of acid, oil, and water is mentioned. This was an anticipation of the Elmore 1901 patent, when the latter was construed in its widest sense, and accordingly the latter could not stand.

The Earl of Halsbury considered that the 1901 patent failed for want of precision, and called attention to the requirement of the statute for a distinct statement in the specification as to what is the invention claimed. He also expressed his dissent from certain views propounded by the Court of Appeal with regard to prior publication. The Court of Appeal had taken the view that a printed description of a process was not sufficient to be deemed an anticipation unless evidence could be brought forward to show that the process had been worked in some sort of practical manner. Lord Halsbury also said he considered that the two inventions were entirely different, one being founded on the selective action of oil and the other upon surface tension.

Lord Atkinson said that there might be three different methods of describing the actual operation of the application of the use of the acid in the 1901 specification: (1) that a small quantity of acid was used in a mixture of oil, ore, and water quite irrespective of the amounts of the three, or of the nature of the oil; (2) that a small quantity of acid was used in a mixture of the three in which there was so much water, or oil and water, as to make a freely flowing pulp, but without specifying how much or how little oil was used; and (3) that a small quantity of acid was used in a mixture of oil, water, and ore with such a large amount of oil as to float the mineral on the surface. As regards the first case his lordship considered that the Everson patent was an anticipation, thus invalidating the 1901 patent. As regards the third, the 1905 patent did not use oil in such large quantities as to float the mineral, but relied on air or gaseous bubbles or froth, and therefore it did not infringe that of 1901. The second was the only argument which required close examination. In the specification there is no express mention of small quantities of oil, and the actual amount of oil used could only be deduced from the general description. From internal evidence his lordship came to the conclusion that the specification called for a large proportion of oil, so that the argument that the patent should be made to cover small quantities of oil fell to the ground.

Lord Shaw also gave a decision to the same effect, touching on the difference between the two processes from the point of view of the large and small amounts of oil used and the application of bubbles and froth in the 1905 patent.

This decision of the House of Lords, though nominally confined to the 1905 and 1901 patents in question, is of general importance. From the judgments we infer that the House of Lords considers the 1901 patent a bad one, and that even if it was not bad, the 1905 process, by introducing gas or bubbles for flotation, is so unlike the process referred to in the 1901 patent as to be no infringement of the latter. We deduce therefore that the 1901 patent cannot be considered as a master patent for all processes using oil and acid with or without the introduction of other methods of flotation. In order to make the position of this litigation quite clear, we would add that it only deals with the British patents, and not with those of any other country. And we would also remind our readers that this dispute has nothing to do with the improved Elmore invention known as the vacuum process, which is at work successfully in various parts of the world.

In writing this precis of the judgment we have assumed that our readers possess some knowledge of the various processes involved; those who have not we may refer to the article in our September issue entitled "The History of the Flotation Processes."

Air - Compressor Explosions. — The Transvaal Government Mines Department is investigating the many cases of explosion or combustion in air-compressors that have occurred, often with fatal results, during the past few months. Apparently the compressors are being overtaxed or else they are insufficiently inspected and cleaned. Complaints are made that the Government authorities have issued no report, warnings, or instructions as the result of their enquiries. A serious accident, resulting in the fatal gassing of several men, occurred on the Langlaagte Deep five months ago, and yet no report has been issued.

Malm Dry Chlorine Process.

Many articles and notices have appeared in the American Press relating to the operation of a dry chlorine process for treating complex ores invented by John B. Malm and exploited by the Western Metals Co. at Georgetown, Colorado. The mineral wealth of this part of the country consists to a large extent of complex ores of blende and galena carrying gold and silver. Some of the richer ores can be sold to the smelters, but those of lower grade have at present no commercial value. Accordingly the trial of any process, however remote its chances, is welcomed by the community. The Malm process comes under this category of processes with remote chances. It is based on the replacement of sulphur by chlorine by the treatment of finely ground ore with chlorine gas, the subsequent extraction of the chlorides by lixiviation, the precipitation of gold and silver on copper and of lead on zinc, and the electrolysis of the zinc chloride in a state of fusion for the production of metallic zinc and for the recovery of chlorine. The process is by no means new. Swinburne and Ashcroft tried it at the Castner-Kellner Alkali Co.'s works at Runcorn and papers were read on it at the time. In spite of liberal and cheap supplies of the chlorine that was over-produced in alkali manufacture, the process could not be made a commercial success. The displacement of sulphur by chlorine is not an easy reaction to work in practice, and the electrolysis of zinc chloride is costly. The success of the Hoepfner electrolytic zinc process at Brunner Mond's works is quoted by the promoters of the Malm process, but the two processes have little or nothing in common. An unusually pure zinc is produced by the Hoepfner process and it commands a high price for special brass work, but, as at the Castner-Kellner works, the chlorine supply is practically gratuitous. Nevertheless we believe that the trouble of working is so great that the process can hardly be rated as remunerative. With this knowledge of previous experience, we are not impressed with the chances of the Malm process.

Electrolytic Refining in Australia.— A paragraph has appeared in the Press to the effect that the electrolytic refining of copper was first started in Australia at the new Port Kembla works of the Electrolytic Refining & Smelting Co. of Australia. As a matter of fact the first installation was that erected by T. C. Cloud at the Wallaroo works in 1891. The second was erected at Lithgow in 1900.

EARLY DAYS ON THE GOLD COAST

By E. T. McCARTHY

AT the end of 1879, I landed at Axim, on the coast of West Africa, with a Mr. Dahse, a German who had secured the extension of the French concession at Taquah known as Effuenta for James Irvine, of Liverpool. With us was a handy man, a carpenter by trade. We camped in a tent on the beach. After a few days, leaving Dahse behind, I set out for the alleged new goldfield by way of the Ancobra and Bonsa rivers. From the Bonsa station to the Taquah range I followed the trail through the wilderness of bush and forest. This trail we, with the French, widened at a later time.

As we climbed over what is now known as Government hill, my companion was suddenly taken ill, with what I then supposed was African fever, but which I now believe was heat-apoplexy. Putting him on a bamboo stretcher hastily constructed he was carried down the hill, where I pitched our tent. My stricken companion was placed in a camp-bed; I did all that I could for him, but after an hour he passed away.

That same night I wrote to Bonnat (three miles away) asking him if it were possible to send a coffin on the next day. The same night Dr. Pigott, together with Tibot and Bonnat, came over, and early next day we buried my friend of a few weeks' acquaintance. The same day I paid my first visit to Taquah.

All of these three men, my first friends at Taquah, subsequently lost their lives in West Africa.

Returning to my camp on the following day, I crawled through the bush to the top of Effuenta hill, where for several weeks I spent a lonely existence, principally engaged in felling trees and putting up barracks for the 200 Kroomen, whom I had brought from the coast.

The West African Goldfields.

My first night in that tent on the hill-top was one ever to be remembered. Just after dark all my men disappeared, even to my interpreter and personal servant. I was alone in the forest, when in the distance and then gradually approaching I heard the sounds of tom-toms and guns. As my boys had disappeared, I came to the conclusion that they had got wind of some trouble and had decamped, and that I was evidently about to be attacked. Leaving my lamp burning in the tent, I took a small Madeira table and chair and placed them far back in the shade of the forest. Placing my gun and revolvers upon the table, I awaited developments. Presently a big crowd of Fantis debouched from the trail and encircled my tent, beating drums vigorously and firing guns. Some of them came pretty close to me, but fortunately failed to see me, for had I been discovered I should most assuredly have fired on them. After what seemed to me an interminable time they drew off and toward morning I crept back to my tent and went to sleep. On waking, I found my boy, and on asking where the men had been the night before I found they had gone to see their friends at Taquah, and the demonstration during the night had been a visit of King Emil and his retinue to welcome me, or, as natives express it, "do custom." My friend Bonnat had told the King to pay me this visit of courtesy.

This was the beginning of my acquaintance with Bonnat, with whom I was subsequently to make many a tough journey and join in many a hard piece of work. Marie Joseph Bonnat was a remarkable man ; as I have already said he was the pioneer of modern gold mining in West Africa, and it is in memory of my old friend that I pen an outline of his life as he gave it to me when we were camping one night on the banks of the Ancobra. I feel sure that the story will interest many who are now taking part in the development of the West African goldfields.

Bonnat was left an orphan when about 16 or 17 years of age. His father (who had been a farmer in central France) left his property mortgaged, whereupon the three brothers finding their resources gone set out for Paris with only a few francs in their pockets. The eldest turned back and afterward became a priest. The other two arrived in Paris and spent their last franc on a night's lodging. As evening came round again they agreed to part, thinking it easier to find work singly than together, but arranged to meet at an appointed place the next day. The brothers never met again.

Bonnat succeeded in getting a place as shoeblack in a hotel; advancing thence into the kitchen, he eventually became *chef*. After some years thus spent, he happened to hear that two African ivory hunters were staying in the hotel; he waylaid them one night as they were about to enter their bed-rooms and begged them to take him with them to Africa as their cook, offering his services for a year for nothing. This resulted in his being engaged by them. He went to West Africa. A few years later the hunters retired, leaving Bonnat in possession of all their belongings, including a small factory on the coast. Then he started business on his own behalf.

It was when returning after a successful hunting expedition laden with ivory, that he was captured by the Ashantis on the Volta river and held by them prisoner for some three years until released with his German fellow prisoners (a Mr. and Mrs. Ramseyer) by Sir Garnet Wolseley in the course of his Coomassie campaign. While a prisoner he was treated at times as a prince and at others with greatest cruelty, depending on the vagaries of the king. At times denuded of every stitch of clothing he was compelled to make mud bricks and at night was often tied to a tree so that he could neither sit or lie down. On other occasions he feasted with the king and was shown all his treasures of gold, which were enormous. It was during one of these visits to the king that he first learnt of the Taquah gold mines and determined, whenever released, to visit them. He carried out his purpose, and returning to France he then endeavoured to form a company to explore and develop the gold deposits by modern methods.

During this visit (which proved unsuccessful) he became engaged to a daughter of a French banker, who, thinking him an adventurer, would not give his consent. Returning again to Taquah and fully convinced of its wealth, he again tried to form a company. This time he succeeded in interesting Verillon. The Taquah & Abosso were then floated under the name of the Cote D'Or company. Soon afterward the Effuenta concession was acquired by James Irvine, of Liverpool, who formed the Effuenta Gold Mining Co. Meantime Crocker, the senior partner of Swanzy & Co., the oldest firm of traders on the Coast, commenced work on a quartz vein a little beyond Abosso. This proved a failure but the attempt led eventually to their working the continuation of the banket deposit at Abosso. This is now the Wassau company's property.

A few months after Effuenta was started, the Gold Coast Co. was formed and commenced work at the opposite end of Taquah on what is now known as Abbontiakoon. These were the pioneer companies of the Gold Coast and they had been attracted thereto through Bonnat's persistence and pluck in bringing the gold deposits to public notice.

When I first entered Taquah, although the king had granted the concession to Bonnat, yet the natives still remained in possession of the mines and it was only by a process of gradual absorption that they were finally eliminated.

Day and night one could hear the women and girls grinding the ore extracted from the hundreds of small shafts situated on the hills and scores of women were to be seen washing out the gold therefrom, standing up to their waists in the swamps behind the town.

In those days all supplies (even to food) had to be imported on the heads of natives, for the plantations around Taquah were not sufficient even to supply the native town itself. Transport, therefore, was not only costly but exceedingly difficult and intricate, as a system of weighing and checking each load at the several stations along the road had to be organized and then again the native carriers were consuming the food and had to be despatched back directly they arrived without a moment's delay.

Bonnat's knowledge of the language and customs of the natives was invaluable in this respect and made comparatively easy what otherwise would have been a gigantic task. Although we were too early, this work ultimately led to the development of the country. It was during these days that Bonnat and myself determined to attempt the riddle of the Kong mountains, a geographical problem then almost as great as the Mountains of the Moon. On all maps a range of mountains, known as the Kong, had been inserted and were supposed to be the cause of the big bend in the course of the Niger. With this object in view we gathered information from native traders. Finally, it was arranged between us that he should go home, collect what equipment we needed, and that I should follow him home just for the voyage and return immediately with him. Accordingly Bonnat started six weeks in advance. On my arrival at Liverpool, I received a telegram from him saying he was married and wished me to come over and join him and his bride near Macon.

It seems that his brother, from whom he had parted as a boy in Paris, had gone to the East, and dying suddenly on his way home had left Bonnat two-thirds of a substantial fortune. Thus the obstacle to his marriage was removed. On meeting Bonnat I did all I could to dissuade him from going back to Africa; but to no purpose. This, he said, was to be his last visit, as unfortunately proved but too true.

Before starting on our journey we made a trip up the Ancobra river to visit some old mines and to re-visit Taquah. It was in the village of Bamiankor that we spent our last night together. Bonnat and I had just sat down to a native dish of 'flou flou' and 'foo foo' when who should walk in but the late Commander Cameron, who, seeing our boat on the river, had reckoned on getting a good meal, as his supplies had become exhausted with the exception of a pint bottle of beer and a small tin of *pâté de foie gras*. With these tucked under his arms, he walked in, much to our surprise. That night the sandflies being so troublesome we sat up, talking, over the fire, Cameron giving us a most interesting account of his journey across Africa.

Next morning I said good-bye to Bonnat, who left with a bad cold, probably contracted in swimming a river, with the understanding that we should start in a week's time. Arriving at Taquah, he was taken ill. He wrote me a note the day before his death, sending it down by native runner and saying he would soon be up again and looked forward to our journey. Apparently he was in the best of spirits. Alas; as I was striking camp a runner came in with a letter telling me that Bonnat had suddenly got worse and was no more. The news was a severe shock to me but how much greater to the woman who had been his bride of six weeks and his betrothed for five long years.

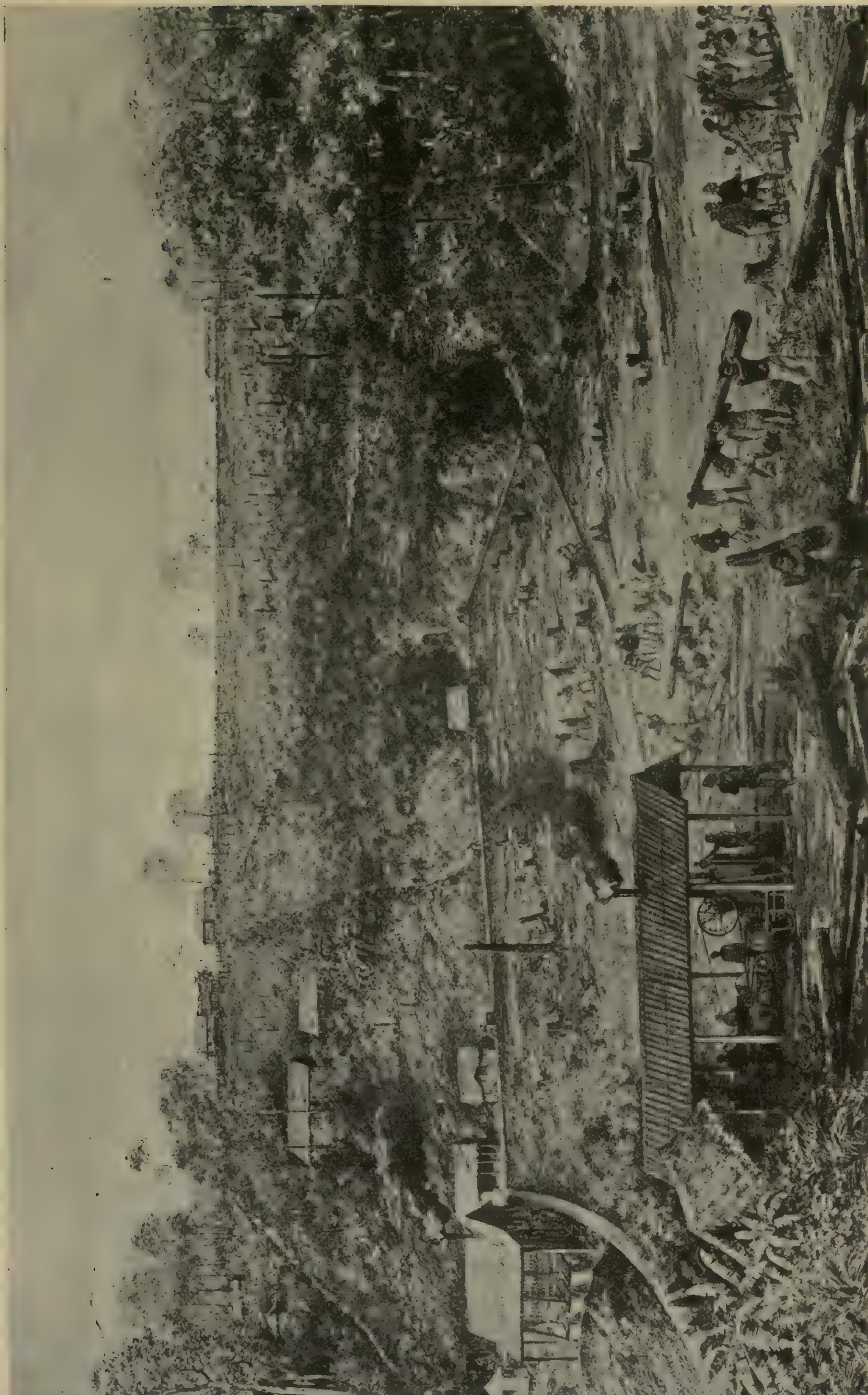
It is of interest to note that the French claim to have imported the first gold from Elmina as long ago as 1382 and 500 years afterward they were led to re-open the Gold Coast to modern enterprise on the initiative of Bonnat, who was truly the father of modern gold mining in West Africa. J. Sketchly was, I believe, the first technical man to examine the Taquah mines; he came in 1877 on behalf of the French and was followed in 1879 by J. H. Harvey, who described the deposit as a "quartz reef," to which I demurred, for it was undoubtedly what is now termed 'banket.'

The accompanying illustration of Taquah as it appeared in 1880 is reproduced from a picture drawn by Tibot. In the background is seen the central part of the low range along which the 'banket' deposit runs, parallel to the ridge. Near the foot of the hill are seen the cross-cuts driven to the ore. The old native mines, consisting of innumerable shafts, are hidden in the bush higher on the slope. In the foreground is the mill with 15 light portable stamps and three Bazain amalgamators and saw-mill. These amalgamators were at that time a French patent for forcing the pulp from the stamps through a bath of quicksilver, but from the first they proved disappointing. The boilers (15 and 20 hp. apiece) are seen well in the foreground; two similar boilers were erected on the Effuenta; all of them were of the water-tube type and they are of interest as being the forerunners of the now famous Belleville boilers, so well known in battle-ship construction. They were adopted on the West Coast on account of their great portability.

The figures represented in the picture are Mons. Tibot advancing to meet the native king and his retinue. Bonnat stands immediately behind Tibot. The king was Emil. After the first Ashanti war he was placed upon the throne by the British Government, whose representatives had captured the former king, his brother, and deported him to Lagos, where he was kept a prisoner for many years. Long after my sojourn on the coast he was reinstated. It may be interesting to add that the natives hid the stool that serves as a throne, and as by native custom no king is recognized unless he sits on this throne, Emil was never properly king. In 1880 the British colony only reached five miles inland from Axim, and all the eastern part of Wassau, to which Taquah belonged, was under the rule of an independent king and his chiefs. During the first Ashanti war these joined the Ashantis against the British; hence the deportation of the king to Lagos. Bonnat and I were shown the stool, together with huge horns made of elephant tusks, which were kept in a little bamboo-thatched hut not far from Taquah, but before being led thither we were sworn on the native oath of 'Manchata' not to reveal it. I quote this to indicate what confidence the Fantis had in Bonnat; he was a man trusted alike by the European and the African.

British Tin during 1908.—The figures for the production of tin in Great Britain during 1908 were published by the Home Office in November. The production of concentrate was 8008 tons containing 5046 tons of metal, as compared with 7080 tons, containing 4406 tons of metal, in 1907. These are the highest figures since 1895. The increase during 1908 is due to the greater activity of Carn Brea & Tincroft and South Crofty, and in a lesser degree to East Pool, Basset, and Dolcoath. Unfortunately in the case of East Pool the advance has not been sustained during 1909. The figures in the report show an interesting fact, namely, that South Crofty sold 133 tons of iron concentrate obtained in the magnetic separation of roasted tin, wolfram, and pyrite. The value of this concentrate is returned at £555, and it is reported to have contained also 5½ tons of tin oxide and 2½ tons of wolframite. The average percentage of metallic tin in the concentrate from the dressing-floors was 65⅓, and in the concentrate obtained from the streams only 45⅞. In addition to the home production, 25,013 tons of concentrate was imported during 1908, an increase of 4132 tons over 1907. Of the total imported, no less than 20,470 tons came from South America. In this connection we may quote the old saying that there is nothing so deceptive as figures. The origin of these South American ores is credited to Chile, Peru, and Argentine because they are exported from ports in those countries, though of course practically all the ore came from Bolivia. Of the rest of the imports into Great Britain 2076 tons came from South Africa and 464 from Nigeria.

Rapid Tunnelling.—Some remarkably rapid and cheap tunnelling is being done in connection with the new water supply for Los Angeles, California. The aqueduct is 240 miles long and passes through several tunnels. One of these, known as the 17 M, will be 10,596 ft. long when completed. The dimensions in cross-section are 10½ by 8½ ft., the top being an arch with a radius of 4 ft. 3 in., and the bottom an invert with a radius of 9 ft. 6 in. During the month of August, working 31 days, a distance of 1061 ft. was driven. At this part of the tunnel the formation is sandstone and the holes were drilled by hand with augers. The ground was broken with eight holes, and the lower heading plan was adopted. Each shift consisted of two miners at the face, two on a movable platform trimming and caving, five shovellers, and a shift-boss, and there were three such shifts under a general foreman. For each linear foot the consumption of explosive was 4·2 lb. of 40% 1⅛ in. ammonia powder and 2·2 lb. black powder. The total cost of the month's work was $5429 for wages, $996 for materials, and $458 for livestock, freight, and handling, a total of $6883. This was equivalent to $6·39 per foot. The tunnel is on the edge of the Mojave desert and the temperature is high. Under such conditions the rapidity of the work is remarkable. The previous best was the run at the Loetschberg in Switzerland last July, when 1013 ft. was driven through limestone, using four air-drills.



Tarkwa in 1880.

RECENT PATENTS

Neutralizing Acid in Smelter Gas.—The question of recovering fume and neutralizing acid in smelter gas is receiving attention in America as has already been mentioned in our paper. C. B. Sprague, of Salt Lake, describes in U.S. patent 931,515 a method of attacking this problem. His invention does not deal with sulphurous acid or other acids in the gaseous state, but with the particles of liquid sulphuric acid that are suspended in the gases or become attached to the metallic fume. If such fume is sent to the bag-house, the acid corrodes the fabric and renders this method of collection useless, and that is why a good deal of acidified fume is still discharged into the atmosphere with attendant loss of metal and damage to agriculture. According to this invention, an oxide or hydroxide is introduced into the smelter gases, in the form of an impalpable powder, for the purpose of neutralizing the acid. The substance that gives the best results is zinc oxide, but owing to its cost, slaked lime is used for the purpose of acting on as much of the acid as possible, and only a small amount of zinc oxide injected subsequently in order to complete the neutralization. The fume, having thus been cleared of the corrosive acid clinging to it, can be satisfactorily treated in the bag-house.

Electrolytic Magnesium. — The usual method of producing metallic magnesium electrolytically is to pass a current through fused magnesium chloride, using some potassium chloride as flux. The specific gravity of this electrolyte is so near that of magnesium that the metal liberated will only under certain conditions and at certain temperatures fall to the bottom of the bath. G. O. Seward and F. von Kugelgen describe in U.S. patent 931,092 a method of overcoming this physical difficulty. Instead of seeking to sink the magnesium they introduce a compound of higher specific gravity into the bath so that the magnesium shall easily float. The substance they prefer is barium chloride, and the constitution of the bath they use is 5 parts of magnesium chloride, 5 parts of potassium chloride and 3½ parts of barium chloride. The magnesium liberated floats in this mixture and can be easily removed.

Treating Ores from Cobalt. — A. G. Betts describes in U.S. patent 927,021 an electrolytic process for treating the complex silver ores mined at Cobalt, Ontario. The chief feature of the process is that no arseniuretted hydrogen is evolved. The ore is first smelted and a speiss produced, which is cast into anodes. The electrolytic bath consists of a solution of copper sulphate, of such a strength that nothing but copper is deposited at the cathode and no hydrogen evolved. As no hydrogen is generated no arseniuretted hydrogen is formed, and the process is rid of one of the dangers of electrolysis in the presence of arsenic. As long as the solution contains 1% of copper there is no danger, and the colour of the solution is a guide. The copper sulphate in the electrolyte reacts on the cobalt, nickel, and iron, and forms sulphates of these metals, which are subsequently recovered from the solution and worked up for their metal contents. The arsenic remains in the solution as arsenious acid and most of it can be crystallized out on cooling. The silver, along with any gold that may be present, is deposited as anode slime and is treated in the usual way. A lead salt such as fluosilicate may be used instead of copper sulphate.

Smelting without Fluxes.—One of the problems in metallurgy is to smelt low-grade oxidized copper ores, especially where the gangue is silicious and fluxes are scarce, as in the case of the Tanganyika Concessions. We believe that the metallurgists in the Congo are trying the method of smelting without melting the gangue. It is therefore of interest to read the specification of U.S. patent 927,283 granted to R. G. Reilly of New York and published in July last. This patent describes a furnace that might be applicable to such conditions. The reducing chamber is air-jacketed, and it has a grate consisting of oscillating fire-bars. These bars are hollow and contain perforated projections, which extend upward. The crude ore is charged into the furnace with the necessary fuel; then currents of air, preliminarily heated in the air-jacket, are introduced through the projections on the oscillating bars of the grate. By this means the hot air is distributed throughout the charge, which is moved about so as to bring all parts of it into contact with the air. The temperature is kept above the point required for the reduction of the metallic constituents, but is not sufficient to melt the gangue. The copper is reduced in the form of granules, so that the ore assumes the character of the native-copper lodes of Michigan. At the end of the process the charge is crushed and the copper extracted by wet concentration.

MEASUREMENT OF PULP AND TAILING. II

By W. J. SHARWOOD

IN ascertaining the weight of solid in a vat filled with uniformly liquid pulp, such as slime in an agitator, a cubic foot or any convenient measured volume may be dried and the residue weighed, whence the weight in the entire volume is obtained by proportion. If the mixture is weighed before drying the percentage of solid in the pulp may also be found.

A much easier and more rapid method is to find the specific gravity of the pulp, either with a hydrometer or by weighing a litre or other convenient volume. The density of the dry solid must also be known, at least approximately. Knowing these two values: specific gravity of mixture (p) and density of dry solid (d), we can at once calculate the weight of dry solid per cubic foot, as well as a number of other factors and relations, by means of the data in Tables I and II, or we may read them directly from a curve (Fig. 1 at end of this article). The volume of pulp in cubic feet and the weight of solid per cubic foot, or the volume in fluid tons and the 'solid factor' (F in Table I) enable us to calculate the tonnage by a single multiplication.

For example, consider an agitator of 16 ft. diam. by 45 ft. deep, containing 7200 cu. ft. or 225 fluid tons of pulp the gravity of which is found by hydrometer to be 1·182, while the density of the dry slime is known to be approximately 2·6. Substituting these values for p and d in the formula for F in Table I we find the value of F to be 29·575 tons solid for 100 fluid tons, whence 225 fluid tons contain 66·5 tons. Or we may substitute the same values in the formula for S, the percentage of dry solid, which is thus found to be almost exactly 25%. Hence again $F = 25 \times 1{\cdot}182 = 29{\cdot}55$, which leads to almost exactly the same result. Also inspection of the curve for F in Fig. 1 shows at once that the solid factor for gravity 1·182 and density 2·6 is approximately 29·5.

If again, instead of determining gravity, we measure out exactly a cubic foot of the pulp, settle and siphon off the solution and dry the residue, we find it weighs 839 grams or 1·85 pounds. Then 7200 cu. ft. $\times$ 1·85 $\div$ 2000 = 66·6 tons.

Where frequent determinations are required of dry tonnage in vats containing slime or ore of nearly uniform character (d = constant) much time is saved by drawing up a table with vertical columns corresponding to depth of pulp, and horizontal lines representing gravity of pulp, the total tons of solid being given at the intersections. A mark can also be established for a given number of fluid tons with a correction for each inch of variation in depth, the volume of pulp thus found being then multiplied by the solid factor corresponding to the observed gravity. A portion of a table used for several years in connection with such a datum mark is given in a later article. This enabled a workman, in less than five minutes, to determine within 2 tons the amount of slime in an agitator containing 100 to 150 tons.

In deep vats, or when agitation is imperfect, samples should be taken at several levels—say near top, middle, and bottom—and the contents corresponding to the gravity found for each layer should be computed separately and then averaged. A less accurate result is generally obtained by using for the computation an average of the three gravity readings. Such layer samples can be drawn off by means of wooden beer-cocks, or simply from half-inch holes closed by wooden plugs. Another method of taking them is to attach a bottle or can to a graduated stick, a string fastened to the cork being pulled at any desired level in order to sample the mixture at that particular depth.

The relations between the specific gravity of a pulp and the percentage of solid and various other factors have been worked out in some detail, and are given in Table I annexed. Table II shows further in a simplified manner the relations found most useful in practical calculations, in forms which admit of fairly rapid computation by slide-rule or otherwise, if advantage is taken of the constants in Table III and the relation of water ratio to percentage given in Table IV. For very many purposes the various values can be read with sufficient accuracy from a curve like Fig. 1, or interpolated from suitable tabulated data.

These formulas apply generally to all cases of water mixtures or emulsions, including slime and mill-pulp. The specific gravity of

TABLE I.—PULP FORMULAS.

d = density or specific gravity of dry solid (ore, sand, or slime).
p = specific gravity of pulp (mixture of water and ore, etc.).
S = percentage by weight of dry solid in pulp.
= grams in 100 grams, tons in 100 tons weight, etc.
R = water ratio of pulp.
= tons water per ton of dry solid.
= grams water per gram of solid.
V = volume-percentage of solid in pulp.
= c.c. in 100 c.c. pulp.
= cubic feet in 100 cu. ft. pulp.
F = solid factor.
= grams solid in 100 c.c. of pulp.
= tons solid in 100 fluid tons or 3200 cu. ft. of pulp.
= avoirdupois ounces in 0·1 cu. ft. of pulp.
k is a constant for any particular solid under consideration, used to facilitate calculation, and depending upon the density of the dry solid.

$$k = \frac{100\,d}{d-1}$$ (See Table III for values of k.)

$$d = \frac{p}{1 - R\,(p-1)} = \frac{S\,p}{S\,p - 100\,(p-1)}.$$

$$p = \frac{R+1}{R+\frac{1}{d}} = \frac{100}{100 - \frac{S\,(d-1)}{d}} = \frac{k}{k-S}$$

$$S = \frac{100}{R+1} = \frac{100\,d\,(p-1)}{p\,(d-1)} = \frac{k\,(p-1)}{p}$$

$$R = \frac{d-p}{d\,(p-1)} = \frac{1-\frac{p}{d}}{p-1} = \frac{100-S}{S}$$

$$= \frac{100}{S} - 1 = \frac{100\,p}{k\,(p-1)} - 1$$

$$F = S\,p = \frac{100\,p}{R+1} = \frac{100\,d\,(p-1)}{d-1} = k\,(p-1)$$

$$V = \frac{F}{d} = \frac{S\,p}{d} = \frac{100(p-1)}{d-1} = (k-100)\,(p-1)$$

Volume-percentage of water in pulp

$$= 100 - V = 100 - \frac{F}{d} = p\,(100-S)$$

$$= \frac{100\,(d-p)}{d-1}$$

Tons of dry solid per 100 tons water

$$= \frac{100}{R} = \frac{100\,S}{100-S} = \frac{100\,d\,(p-1)}{d-p}$$

Fluid tons pulp to yield one ton solid

$$= \frac{100}{F} = \frac{100}{k\,(p-1)} = \frac{R+1}{p}$$

water is taken as 1 and no corrections are made for temperature, air-buoyancy, etc. They are applicable to ordinary mixtures of cyanide solutions with slime, etc., except for very small percentages of solid, but do not apply to mixtures with sea-water (sp.gr. 1·03), nor to heated or highly alkaline waters, except for purposes of rough approximation.

Very Thin Pulp.—For excessively thin mixtures, such as turbid water, or the overflow from efficient clarifying tanks or dams, and for all pulp of gravity less than 1·01, the gravity must be determined with the utmost care. When the percentage of solid is so very low its influence on the gravity may become less than that of ordinary variations of temperature, or of small proportions of dissolved salts. In such extreme cases, or where the proportion of dissolved salts is considerable, it is best to determine the percentage of suspended solid by filtering a measured quantity through an ashless filter-paper, drying and brushing off the residue, burning the paper and weighing the ash and residue together. The bulk of the solid must not be ignited with the paper or the result will be low, owing to decomposition or sulphides, carbonates, or hydrous silicates.

It is noteworthy that in the case of extremely thin pulps, having gravity under 1·05 or weighing less than 66 lb. per cu. ft., the values of S, F, and A (and also of 'sluicing efficiency' where this is applicable) are nearly identical and approach closely to the common value $k\,(p-1)$, which can be used to calculate them without serious error, provided the gravity of the pulp be determined with sufficient accuracy. We have then:

For values of p under 1·05	S or percentage by weight of dry solid F or tons solid in 100 fluid tons of pulp A or tons dry solid in 100 tons of water (and sluicing efficiency where applicable)	$= k\,(p-1)$ approximately;

the approximation being closer as the gravity approaches unity.

This approximation is often close enough for the overflow of certain slime-settlers, spitzkasten, cones, etc., but must be used with due caution.

Sluicing Wet Material.—When wet sand is sluiced out of treatment-vats and collecting-tanks, or slime-cakes from filter-presses, etc., by means of a stream of water or solution, calculations are complicated by the fact that the resulting mixture contains

TABLE 11—WATER AND SOLID IN PULP.

	WEIGHT PULP.	VOLUME PULP.	WEIGHT DRY SOLID.	WEIGHT WATER.	VOLUME WATER.
ONE TON OF PULP (2000 Pounds)	1 Ton	$\frac{1}{p}$ Fluid Ton $\frac{32}{p}$ Cu. Ft.	$\frac{S}{100}$ Ton $\frac{1}{R+1}$ Ton $\frac{(p-1)k}{100p}$ Ton	$\frac{d-p}{p(d-1)}$ Ton	$\frac{d-p}{p(d-1)}$ Fl. Ton $\frac{32(d-p)}{p(d-1)}$ Cu. Ft.
ONE FLUID TON OF PULP (32 Cubic Feet 240 U.S. Gallons, 200 Imperial Gallons)	p Tons	1 Fluid Ton 32 Cu. Ft.	$\frac{(p-1)k}{100}$ Ton	$\frac{d-p}{d-1}$ Ton	$\frac{d-p}{d-1}$ Fl. Ton $\frac{32(d-p)}{d-1}$ Cu. Ft.
ONE CUBIC FOOT OF PULP (7·5 U.S. Gallons, 6·25 Imperial Gallons)	62·5 p Pounds	1 Cu. Ft. 0·03125 Fl. Ton	0·625 $(p-1)k$ pounds $\frac{(p-1)k}{3200}$ Ton	$\frac{62{\cdot}5(d-p)}{d-1}$ pounds $\frac{d-p}{32(d-1)}$ Ton	$\frac{d-p}{d-1}$ Cu. Ft.
ONE TON OF DRY SOLID (2000 Pounds)	$R+1$ Tons $\frac{100p}{(p-1)k}$ Ton	$\frac{100}{(p-1)k}$ Fl. Ton $\frac{3200}{(p-1)k}$ Cu. Ft.	1 Ton	R Tons $\left(\frac{100}{S}-1\right)$ Ton $\frac{d-p}{d(p-1)}$ Ton	32 R Cu. Ft. R Fluid Tons
ONE FLUID TON OF WATER (32 Cubic Feet, 240 U.S. Gallons, 200 Imperial Gallons)	$\frac{p(d-1)}{d-p}$ Ton	$\frac{d-1}{d-p}$ Fl. Ton	$\frac{1}{R}$ Ton $\frac{d(p-1)}{d-p}$ Ton $\frac{S}{100-S}$ Ton	1 Ton	1 Fluid Ton 32 Cu. Ft.

ONE U.S. GALLON PULP $= \frac{(p-1)k}{12}$ pounds dry solid. ONE IMPERIAL GALLON PULP $= \frac{(p-1)k}{10}$ pounds dry solid.

METRIC VALUES.—The relation between the Metric Ton (of 1000 kilograms) and the Cubic Metre (1000 Litres) is identical with that existing between the Ton of 2000 pounds and the Fluid Ton of 32 cubic feet. For instance, one Cubic Metre of pulp contains 0·01 $(p-1)k$ Metric Ton dry solid.

TABLE III—VALUES DEPENDING ON DENSITY OF DRY SOLID IN MIXTURE.

DENSITY OF DRY SOLID d	Values of $k = \frac{100\,d}{d-1}$	Values of $27\,k$	Values of $\frac{100}{k} = \frac{d-1}{d}$
2·2	183·3	4950	0·545
2·3	176·9	4780	0·565
2·4	171·4	4630	0·583
2·5	166·7	4500	0·600
2·6	162·5	4390	0·615
2·7	158·8	4290	0·630
2·8	155·5	4200	0·643
2·9	152·6	4120	0·655
3·0	150·0	4050	0·667
3·1	147·6	3985	0·677
3·2	145·5	3930	0·687
3·3	143·5	3875	0·697
3·5	140·0	3780	0·714
4·0	133·3	3600	0·750
5·0	125·0	3375	0·800
6·0	120·0	3240	0·833

TABLE IV.
CORRESPONDING VALUES OF PERCENTAGE AND WATER RATIO.

Percentage Dry Solid S or C	Water Ratio R or M	$\frac{1}{R}$	Percentage Dry Solid S or C	Water Ratio R or M	$\frac{1}{R}$
1	99·0	0·0101	33·33	2·0	0·500
2	49·0	0·0204	35·0	1·857	0·5385
3	32·33	0·0309	36·36	1·75	0·5714
4	24·0	0·0417	40·0	1·5	0·6667
5	19·0	0·0526	44·44	1·25	0·800
6	15·67	0·0639	45·0	1·22	0·8181
6·25	15·0	0·0667	50·0	1·0	1·00
6·67	14·0	0·0714	57·143	0·75	1·333
7	13·286	0·0753	60·0	0·667	1·50
7·69	12·0	0·0833	62·5	0·60	1·667
8	11·5	0·0870	65·0	0·538	1·857
8·33	11·0	0·0909	66·67	0·50	2·00
9	10·101	0·0990	70·0	0·428	2·333
9·09	10·0	0·100	75·0	0·333	3·0
10	9·0	0·1111	80·0	0·25	4·0
11	8·091	0·1236	83·3	0·20	5·0
11·1	8·0	0·125	85·0	0·176	5·66
12	7·333	0·1363	85·7	0·167	6·0
12·5	7·0	0·1428	87·5	0·143	7·0
14·28	6·0	0·1667	88·89	0·125	8·0
15	5·67	0·1765	90·0	0·111	9·0
16·66	5·0	0·200	90·91	0·10	10·0
20	4·0	0·250	95·0	0·0526	19·0
22·22	3·5	0·2857	95·28	0·05	20·0
25	3·0	0·3333	98·04	0·020	50·0
28·57	2·5	0·400	99·01	0·01	100·0
30	2·333	0·4286			

Fig. 2. Specific-gravity Flask.

water from both sources. The additional data necessary for computing the proportion of added water to solids, etc., based on measurements of the final mixture, are given in Table V. Many other problems dealing with the addition to pulp of further quantities of water or solution can be solved by application of the same data in conjunction with the preceding tables.

TABLE V.

FORMULAS FOR SLUICING MOIST SLIME-CAKES AND RESIDUES.

C = percentage of dry slime in cakes, or of sand in drained residues, etc., prior to sluicing.

M = water ratio for material sluiced prior to sluicing

$$= \frac{\text{percentage of water}}{\text{percentage of dry solid}} = \frac{100 - C}{C} = \frac{100}{C} - 1$$

E = net sluicing efficiency = tons of dry solid moved by 100 tons of added sluicing water.

R and S = water ratio and percentage of solids in the resulting pulp (see Tables I and II).

Q = tons sluicing water required per ton of dry solid in material sluiced, in order to yield a product of percentage S or water ratio R.

$$E = \frac{100}{R - M} = \frac{C\,S}{C - S}$$

$$Q = R - M = \frac{100}{S} - \frac{100}{C} = \frac{100\,(C - S)}{C\,S} = \frac{100}{E}$$

Tons added water per gross ton of wet material sluiced

$$= \frac{Q\,C}{100} = \frac{C\,(R - M)}{100} = \left(\frac{C}{S} - 1\right) = \frac{C}{E}$$

Density of Dry Solids.—The density of dry sand or slime is best found by means of a weighing-bottle. The weight of the bottle full of water at 15° to 20° C (60° to 70° F) is found once for all. A quantity of the wet sand or slime is then put in the bottle and covered with water. Air-bubbles are shaken out as far as possible and finally removed by suction; the bottle is then filled with water and weighed again. Finally it is emptied, rinsed out, and the sand or slime is collected, dried thoroughly, and weighed.

Density (d) =

$$\frac{\text{Weight of dry sand}}{\text{Wt. bottle with water} + \text{Wt. dry sand} - \text{Wt. bottle full of sand and water.}}$$

If the sand is first dried and weighed, and a definite quantity weighed out for the test, the result is usually too low unless the mixture is boiled or given a long soaking. This has been fully discussed by Caldecott,* who seems to have been the first to note the difference. The result should be calculated to the second place of decimals.

It is important that the sand be well dried before weighing, as any residual moisture lowers the apparent density. If the true density is d and the material is weighed when containing n per cent. of moisture, the apparent density will be:

$$\frac{100\,d}{100 + n\,(d - 1)}$$

For instance, slime having a true density of 2·5 would, if finally weighed when containing 2% moisture, show an apparent density of $\frac{250}{103} = 2{\cdot}425$; similarly with an ore of density 3·5, the presence of 2% of water would reduce the apparent value to $\frac{350}{105} = 3.33$

The size of bottle appropriate depends on the sensitiveness of the balance used; one of 25 to 50 c.c. capacity answers with an analytical or good pulp balance, one of 200 to 1000 c.c. is suitable with scales only sensitive to a decigram. The tin litre flask described below can be used on a balance turning with a single gram, if a large enough weight of material is taken, say, at least 200 grams of dry sand.

ESTIMATION OF SPECIFIC GRAVITY OF PULP.

Hydrometer.—The hydrometer can be used in slime-pulp when it is not extremely thick. It fails when the material settles rapidly, first on account of the upper stratum of liquid losing much of its suspended solid during the reading, secondly on account of particles settling on the bulb of the instrument. The glass instruments having a range from 1·00 to 1·50 can be used, but it is preferable to obtain several of smaller range: say 1·0 to 1·2, 1·2 to 1·4, etc. For thin slime-pulp the very sensitive form known as the urinometer (range 1·0 to 1·060) can be used with advantage. A cylinder of galvanized iron is best substituted in the mill for the usual glass cylinder. Metal hydrometers might be used but the graduations are less easily read. It is advisable to test the accuracy of the instrument by immersion in water (sp. gr. 1·0) and in some heavy liquid, such as strong brine, the specific gravity of which has been

* Proceedings Chem. & Met. Soc. South Africa Vol. II, p. 375.

TABLE VI. PULP-VALUES.

For pulp ranging in specific gravity up to 1.60, and for solids ranging in density from 2.4 to 3.0.

	DENSITY OF SOLID	FACTOR	SPECIFIC GRAVITY OF PULP = p = HYDROMETER READING														
			1.01	1.03	1.05	1.07	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60
VALUES OF S = PERCENTAGE BY WEIGHT OF DRY SOLID IN PULP $= \frac{k(p-1)}{p}$	d	k															
	2.4	171.43	1.70	5.00	8.16	11.21	15.58	22.8	28.57	34.28	40.3	44.5	49.0	53.1	57.14	60.83	64.28
	2.6	162.5	1.61	4.73	7.74	10.63	14.77	21.2	27.08	32.50	37.5	42.1	46.5	50.4	54.13	57.66	61.00
	2.8	155.55	1.54	4.53	7.41	10.17	14.14	20.3	25.92	31.11	35.9	40.4	44.4	48.3	51.85	55.13	58.33
	3.0	150.0	1.485	4.37	7.15	9.81	13.64	19.56	25.00	30.00	34.6	38.9	42.9	46.6	50.00	53.22	56.25
VALUES OF R = RATIO OF WATER TO DRY SOLID BY WEIGHT $= \frac{d-p}{d(p-1)}$	2.4		57.9	19.0	11.25	7.91	5.42	3.48	2.50	1.917	1.526	1.250	1.042	0.880	0.750	0.644	0.555
	2.6		61.2	20.1	11.9	8.40	5.77	3.72	2.69	2.075	1.666	1.373	1.154	0.983	0.846	0.733	0.641
	2.8		64.0	21.1	12.5	8.83	6.07	3.92	2.86	2.215	1.786	1.480	1.250	1.071	0.929	0.811	0.714
	3.0		66.3	21.9	13.0	9.18	6.33	4.11	3.00	2.333	1.889	1.572	1.333	1.148	1.000	0.878	0.778
VALUES OF F = SOLID FACTOR = TONS DRY SOLID IN 100 FLUID TONS = GRAMS SOLID IN 100 CC. $= k(p-1)$ **		k															
	2.4	171.43	1.714	5.143	8.571	12.0	17.14	25.71	34.28	42.86	51.43	60.0	68.57	77.14	85.71	94.28	102.8
	2.6	162.50	1.625	4.875	8.125	11.37	16.25	24.37	32.5	40.62	48.75	56.87	65.0	73.12	81.25	89.37	97.50
	2.8	155.55	1.555	4.666	7.777	10.89	15.55	23.33	31.11	38.89	46.66	54.44	62.22	70.0	77.77	85.55	93.33
	3.0	150.00	1.50	4.500	7.500	10.50	15.00	22.50	30.0	37.50	45.0	52.50	60.0	67.50	75.0	82.50	90.00
VALUES OF V = PERCENTAGE BY VOLUME OF SOLID IN PULP = CCS SOLID IN 100 CC. $= (k-100)(p-1)$		k − 100															
	2.4	71.428	0.714	2.143	3.571	5.000	7.143	10.71	14.28	17.86	21.43	25.0	28.57	32.14	35.71	39.28	42.86
	2.6	62.500	0.625	1.875	3.125	4.375	6.250	9.37	12.50	15.62	18.75	21.87	25.00	28.12	31.25	34.37	37.50
	2.8	55.555	0.555	1.666	2.778	3.889	5.556	8.33	11.11	13.89	16.66	19.44	22.22	25.0	27.78	30.55	33.33
	3.0	50.000	0.500	1.50	2.500	3.500	5.000	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00
VALUES OF A = TONS DRY SOLID PER 100 TONS WATER = GRAMS SOLID IN 100 CC. WATER $= \frac{100}{R}$	2.4		1.726	5.25	8.89	12.63	18.5	28.7	40.0	52.2	65.5	80.0	96.0	113.6	133.3	155.3	180.0
	2.6		1.635	4.97	8.38	11.9	17.3	26.9	37.15	48.1	60.0	72.8	86.6	101.7	118.2	136.4	156.0
	2.8		1.563	4.75	8.00	11.33	16.5	25.5	35.0	45.2	56.0	67.6	80.0	93.3	107.5	123.3	140.0
	3.0		1.508	4.67	7.70	10.88	15.8	24.3	33.3	42.9	52.9	63.6	75.0	87.7	100.0	114.0	128.6
NUMBER OF FLUID TONS PULP TO YIELD ONE TON DRY SOLID $= \frac{100}{(p-1)k}$ ***		$\frac{100}{k}$															
	2.4	0.58333	58.33	19.44	11.66	8.33	5.833	3.889	2.916	2.333	1.944	1.667	1.458	1.296	1.167	1.060	0.972
	2.6	0.61461	61.46	20.48	12.29	8.78	6.146	4.096	3.073	2.458	2.048	1.756	1.536	1.365	1.229	1.117	1.024
	2.8	0.64286	64.28	21.43	12.86	9.18	6.428	4.286	3.214	2.574	2.143	1.836	1.607	1.428	1.286	1.169	1.071
	3.0	0.66667	66.67	22.22	13.33	9.52	6.667	4.444	3.333	2.667	2.222	1.905	1.667	1.481	1.333	1.212	1.111

** These values multiplied by 0.625 or divided by 1.6 give POUNDS DRY SOLID PER CUBIC FOOT OF PULP.

*** These values multiplied by 32 give CUBIC FEET OF PULP TO YIELD ONE TON DRY SOLID.

determined by means of a standardized hydrometer or by accurate weighing in a flask.

Flask.—The specific-gravity flask affords another rapid method, a measured volume of pulp being weighed. Glass flasks are satisfactory in the laboratory, but for mill-work it is best to use one of metal. A pattern that answers well is a conical vessel of tinned iron plate, made to hold exactly 1000 c.c. If of 60° angle the internal diameter at bottom must be about 6·5 inches and the side the same (see Fig. 2). For sampling uniform pulp the mouth is made small and round. For sampling a stream with a tendency to segregation it is best to add a narrow rectangular mouth-piece or a similar funnel, the slot being long enough to cover the full horizontal cross-section of the falling stream. The final adjustment of volume is made by trimming the mouth-piece to a horizontal plane and 'peaning' the bottom with a small hammer, until the water contained when exactly full is within ½ gram of 1000 grams. A tare weight is made to balance the flask when full of water, additional gram weights then indicate the fractional part of the gravity ($p - 1$). A balance weighing to one gram, such as Roberval or trip scale, is used with this; it is not usually necessary to weigh closer than to the nearest 5 grams, giving the gravity within 0·005. When not in use the flask is rinsed out and inverted to avoid accumulation of sand.

Cubic-Foot Bucket.—For approximate work a bucket holding exactly a cubic foot, or up to 3 cu. ft., may be used, being weighed on a platform-scale. It should be cylindrical, of stout sheet iron, with a heavy bail and stiffened rim. The larger sizes require two handles. A convenient size for 1 cu. ft. capacity is 14 in. diam. inside and 13 in. deep; a cubic foot of water fills this to about 11·25 in. from bottom. By making it 20 in. deep 100 lb. water can be accommodated, the level then being about 18 in. from bottom. Graduation is effected by weighing 62·5 or 100 lb. water, boring a small hole at the surface mark and inserting a rivet or small bolt. A narrower form, say 12 in. diameter and 17 in. depth for 1 cu. ft., admits of more accurate measurement, but the additional height is inconvenient. A small tare weight should be made to fit the hanger of the platform-scale, balancing the empty bucket. The platform-scale should have a top lever to release all knife-edges. The cubic-foot bucket gives gravity when the net weight in pounds is multiplied by 0·016, while it may be read directly from the 100 lb. sampler.

GRAPHIC SOLUTION OF PROBLEMS.

The curves illustrated in Fig. 1 embody the principal factors for pulp containing solids of density 2·6 and 2·8. If plotted on a large sheet of squared paper they may be used to read off the values with only a small percentage error except near the extreme ends, or between the abscissae representing specific gravities 1·05 and 1·50. Numerical data for plotting similar curves for solids of density 2·4, 2·6, 2·8 and 3·0 are given in Table VI, covering pulp of any specific gravity up to 1·6; the values given being plotted as ordinates on abscissae representing the specific gravity of the pulp. For material of any intermediate density the ordinates of the curves are obtainable with sufficient accuracy by interpolation. Table VII contains similar data for a curve of sluicing values, starting with filter-cake or residues containing 33·3% water; further data in Table VIII enable the extension of this to material carrying 25 to 40% water.

Photographic reproductions of curves for ore of a particular gravity can be used for ordinary approximations and can be carried in a pocket-book. The most frequent use of such a curve is to read certain constants of a pulp, such as the percentage of solid, starting with the specific gravity. It can be used for computation in many other ways, and most of the numerical problems bearing on pulp can be solved graphically by means of it. In general the first step is to find the specific gravity of the pulp if this is not given.

If it is required to find the amount of slime that can be handled in a vat that will hold 500 tons of water, the dry slime having a density of 2·7 and being mixed with twice its weight of cyanide solution, we first proceed to find the gravity of pulp that corresponds to a water ratio of 2·0. Noting in Fig. 1 where the horizontal line corresponding to 2·0 cuts the water-ratio curves for density 2·6 and 2·8; midway between these would be the intersection of the 2·7 curve, at a point corresponding nearly to the abscissae for specific gravity 1·265. Following a vertical line through this point to where it cuts the curves for the 'solid factor,' we see that for a density of 2·7, midway between 2·6 and 2·8, the intersection would fall close to the horizontal line through 42. That is to say 100 fluid tons of pulp would contain 42 tons of solid matter under the conditions named, or a vat of 500 fluid tons capacity would accommodate 210 tons. With this would be twice its weight of solution, or a total of 630 tons of pulp, of a gravity 1·265 which corresponds to about 79 lb. per cubic foot.

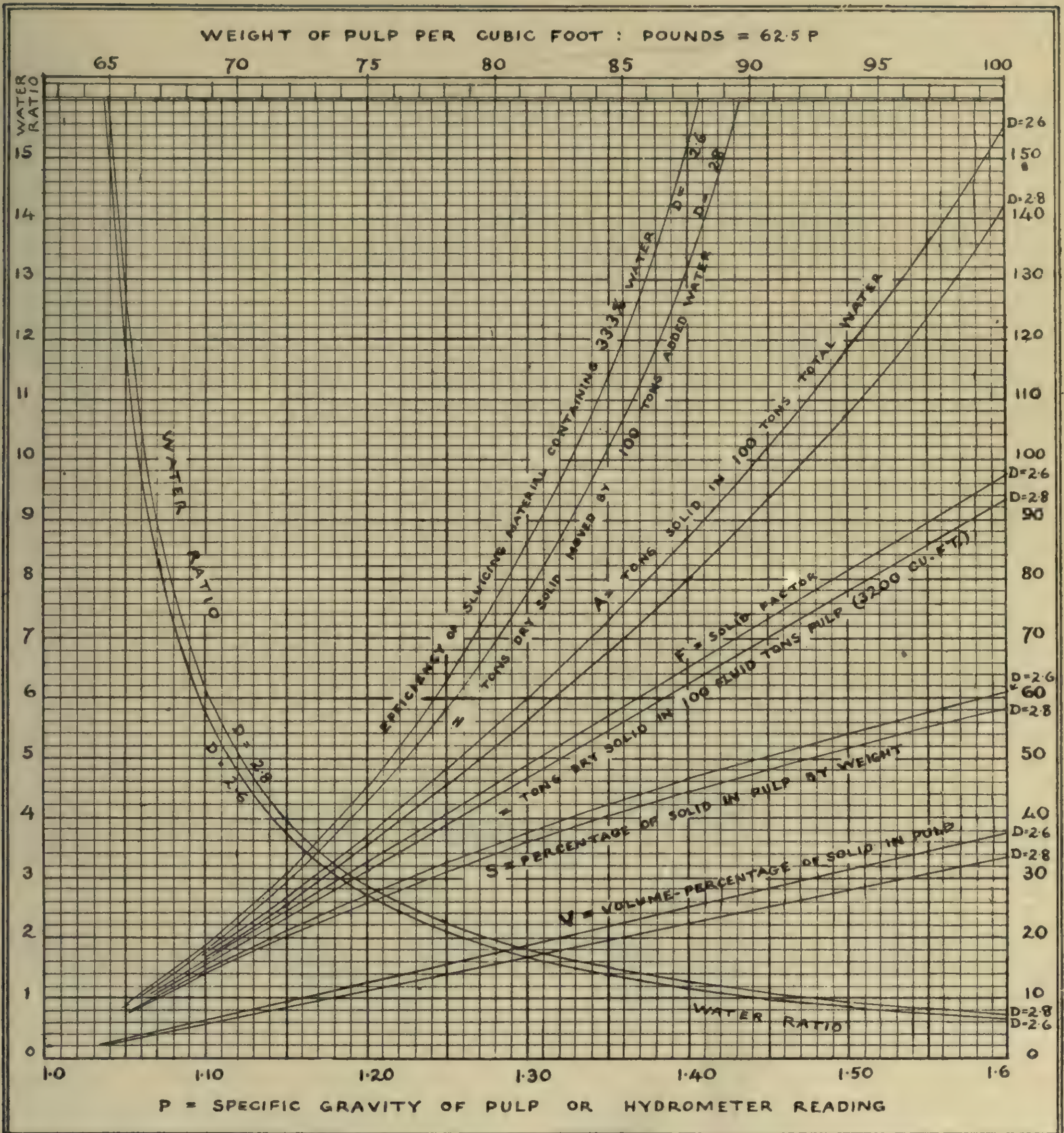


Fig. 1. Ratios of solid and liquid in pulp containing solids of density 2·6 and 2·8.

PERSONAL

F. C. BRAY, recently at Abosso, West Africa, is returning to England.

W. M. BREWER, of Vancouver, was at New York during November.

HERBERT T. BUTCHER is in Algeria.

DONALD F. CAMPBELL has returned to London from Germany.

C. L. CONSTANT JNR. was recently in Ontario.

J. H. CURLE writes from Teheran.

H. S. DENNY has returned from London to Mexico.

GEORGE G. DIXON has gone to Liberia, West Africa.

A. E. DRUCKER has arrived in London on his tour to the principal gold-mining regions of the world. He will return to Korea.

S. F. EMMONS recently received the honorary degree of Doctor of Science from his alma mater, Harvard University.

F. LYNWOOD GARRISON was recently in Mexico.

ALLAN GIBB, resident engineer for the Tanganyika Concessions, has arrived in London.

F. W. HARBORD was due at Johannesburg about November 18. He has been engaged by the Transvaal Government to report on the coal and iron resources of the Transvaal.

FREDERICK H. HATCH is consulting mining engineer, not "advisory geologist," to the Natal government; he will return to London in December.

C. S. HERZIG postponed his return to Nicaragua and has been in Nevada.

C. BARING HORWOOD is manager for the Randfontein South mine at Johannesburg.

J. POWER HUTCHINS is in London, on his return from the eastern coast of Siberia.

A. MCARTHUR JOHNSTON, of Johannesburg, is on a visit to England.

C. B. KINGSTON is returning to the Rand, after a visit to England and Canada.

ROBERT LINTON has been appointed manager for the Sierra Mining Co., in Chihuahua, Mexico.

F. H. MASON, on recovery from illness, is now at San Diego, California.

AUGUST MATHEZ has opened an office at 42 Broadway, New York.

JOHN W. MERCER passed through London on his way to the Continent.

WALTER MCDERMOTT is on his way to Johannesburg.

C. ALGERNON MOREING has returned from the Black Sea region.

EDWARD H. NUTTER has returned from Alaska to San Francisco.

THOMAS PASCOE, recently manager of the Mount Boppy mine, in New South Wales, has opened an office at 509 Salisbury House, London Wall.

ARTHUR L. PEARSE is on his way back from Alaska.

WALTER G. PERKINS is in London, and expects shortly to return to San Francisco.

C. W. PURINGTON has arrived in London from Eastern Siberia.

FORBES RICKARD has returned to Denver from Rhyolite, Nevada.

F. G. A. ROBERTS, manager of the Knight's Central, Johannesburg, is visiting England.

C. M. ROLKER is back from California.

N. SAMWELL is expected in London from Rangoon.

H. KILBURN SCOTT has been in Spain.

F. F. SHARPLESS recently examined the Alice mine in Colorado.

HOWARD D. SMITH has gone with a prospecting expedition to French Guinea.

E. GYBBON SPILSBURY has been examining mines at Tonopah, Nevada.

J. E. SPURR has completed an inspection in the State of Washington.

LESTER W. STRAUSS is examining copper mines near Iquique, Chile.

J. W. SUTHERLAND, manager of the Golden Horseshoe mine, is here from Kalgoorlie.

H. A. TITCOMB is at Salt Lake City, in connection with the Silver King litigation.

W. H. TREWARTHA-JAMES has arrived in London; he is manager of the Tyee Copper Co., at Victoria, B.C.

GILBERT WALKER arrived at Cape Town in November to negotiate with the Government for the establishment of a steel industry.

HARRY H. WEBB has returned to London from New York and California.

G. E. WEBBER is returning to Johannesburg, much improved in health.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Wet Assay of Tin Ores.

The Editor:

Sir — I am glad to learn that Mr. J. J. Beringer, in the interesting communication that appeared in the last number of your magazine, strongly advocates the application of the wet method of assay for the purpose of controlling the various operations in the dressing or concentration of tin ores. It is now well known that the losses in tin-dressing, even with the most complete appliances known, are necessarily heavy, but no general systematic effort has been made in Cornwall for the purpose of determining the extent of these losses.

I remember that in the early sixties (1863, I think) the subject of the loss of tin in dressing came up for discussion at a meeting of the Miners' Association of Devon and Cornwall, held at the Polytechnic Hall, Falmouth, at which there was a large attendance of mining agents. The general impression formed from the evidence presented at the discussion was that the loss of tin in dressing, from the stamps to the tin-hutch, was very trifling, and that it was safe to estimate that the black tin sold corresponded closely to the assays of the ore, by vanning, before going to the stamps. I was asked by the chairman of the meeting (the late Charles Fox) whether I was prepared to furnish any evidence bearing on the subject. In the few remarks I made in reply I stated that if the exact quantity of tin could be determined by some method, other than vanning, the losses would be found to be not less than 25% of the tin contained in the crude ore. I need scarcely say that my remarks were not received in any friendly spirit by the mining men present. This was an opinion expressed 46 years ago, and I confess at this time that my views have not materially changed on this question. In well conducted establishments great improvements have been introduced in the system of tin-dressing in Cornwall as compared with 46 years ago, especially in the recovery from the slime, but there is still room for further improvement.

Until within the last few years (10 years at the most) no satisfactory method was known for the quick determination of tin in an ore. The only guide was the 'vanning shovel,' which even in skilful hands could only furnish approximately the percentages of tin present, and this crude method is at this time the only means in general use for ascertaining the value of tin ores in the condition before delivery at stamps. I believe the custom is to debit the dressing department with the tin contents as ascertained by vanning, and to credit the account with the actual sales of black tin sold, but it must be borne in mind that the black tin so credited is 'wet weight' as against the 'dry weight' indicated by assay on the debit account. The black tin as sent to the smelting works contains on an average about 7% of water, in addition to the actual black tin. A mine, for example, that is credited with producing an ore yielding on dressing 40 lb. black tin per ton should be credited with 37·2 lb. only, the difference between 40 lb. and 37·2 lb. being water.

It has often occurred to me during the last few years that the time had arrived for making some radical change in the system of determining the value of tin ores, and since reference has been made to the question by such an authority as Mr. Beringer I feel no hesitation in expressing my views thereon. In the first place, I see no reason why tin should be commercially treated in any different way from all the other useful metals. Gold, silver, copper, zinc, lead, bismuth, antimony, and arsenic ores, are all assayed and their value determined on the basis of the actual percentage weight of the metals found by assay. Tin is an exception to the rule. The only difficulty that has presented itself, up to a comparatively recent date, has been the want of an easy and satisfactory method for assaying the ore in its crude condition. We now learn from Mr. Beringer that this difficulty no longer exists, for we are assured by him that there is more than one method simple in execution and sufficiently accurate for all commercial purposes.

It will not be found desirable to dispense with the vanning test in its general application, for it affords a ready method for determining the relative value of the ores as produced from the various workings in a mine. There would be no difficulty in preserving the samples from which the vanning assays are made and periodically determining by wet method the exact percentage of metal present. The black tin obtained by the vanning assays should also be preserved and the white tin determined by the wet method as a check on the general results. I need not here go into details for carrying out such a scheme as I have suggested, for they could easily be worked out by any person who would be prepared to give the matter careful consideration. What we require to know particularly is the actual tin contents of the ore that is delivered to the dressing department and what percentage of this tin is actually recovered.

The application of the wet assay as a means of controlling the various operations in tin-dressing, as Mr. Beringer suggests, will be found to be of great value if carefully carried out. The selection of a quick and reliable method for the wet assay of tin may be left to the good judgment of Mr. Beringer. I desire to call attention to one point in Mr. Beringer's communication. He states, when describing the methods proposed for getting tin in solution from native tin oxide: "or it can be effected by Mr. Richard Pearce's method, in which the ore is fused with caustic soda or potash, or with sodium peroxide in a nickel or iron dish, ladle, or crucible to be followed by the solution of the fused mass in hydrochloric acid." I wish to state that I am not entitled to any credit whatever for the adoption of this method. I first saw it in use in the laboratory of Williams Harvey & Co., at Hayle, some four or five years ago. The method had been worked out in all its details by Ernest V. Pearce, and I was so struck with its simplicity and accuracy that I did not hesitate to endorse it as being especially applicable to general use in tin determination. On my return to my home in Denver I found that A. H. Low, a well known chemist and assayer, was about to publish a book on 'Technical Methods of Ore Analysis,' and learning from him that he was not in possession of any satisfactory method for tin determination, I did not hesitate for a moment to recommend the scheme that I had recently seen adopted in Cornwall. With Mr. Ernest V. Pearce's consent, which was procured by cable, the method was published in Mr. Low's new work and due credit was given to the actual originator.

RICHARD PEARCE.

London, November 26.

Mining Education.

The Editor:

Sir—One of the commonest criticisms one hears as to the ability shown by the individual mining engineer is that "He lacks perspective —an adequate sense of proportion." This is obviously most observable in the case of the recent graduate and my own experience is that in no subject is this defect so noticeable as in descriptive geometry.

Perhaps, the mining engineer, more often than others, is required to make a mental picture of things in three dimensions, and, if he specialize along the lines of mining geology the interpretation of every physical feature in most metal mines requires a grasp of their relative position in the mass. The problems presented to mining engineers are, in the majority of instances, either mechanical or structural and to arrive at a correct solution of any such problem a thorough understanding of the graphical geometric presentation of the facts is absolutely essential. While all the engineering schools teach descriptive geometry, it is seldom that one finds a newly graduated engineer who has clearly comprehended the subject and who is able to construct cross-sections, simple or isometric projections, or accurately represent geologic phenomena, especially when the structure is complicated by folds or faults.

It is to the schools of engineering that we must look to supply the profession with men having the proper fundamental knowledge to make them as efficient as possible when they secure their first employment in the field.

FRED T. GREENE.

Wardner, Idaho,
October 31.

Labour in Mines.

The Editor:

Sir—I was pleased to see that C. S. H., in his answer to my letter on H. C. Hoover's 'Principles of Mining,' agrees with me in that it is possible to stope a less width than 30 inches; we differ only in that he thinks this is a practical minimum width, while I contend that narrower stopes can sometimes be profitably worked.

C. S. H. seems to think that he has established 30 inches as a minimum width, by stating that this width has been adopted on the Rand, and that some of the many hundreds of mining engineers working in that district would have introduced a less width had they thereby been able to reduce the working costs. This statement assumes a low working cost as the ideal of mining, whereas, as C.S.H. knows perfectly well, the maximum profit should be the true ideal of the engineer. That this ideal is sometimes forgotten on the Rand, and that the width of the stopes is not always determined by the consideration of the profit, can be seen by anyone who will read H. Musson Taylor's article on 'The Relation of Costs to Profits in Mines on the Rand' in the *South African Mining Journal*, July 17, 1909, and the discussions in that and other journals elicited by this article.

The general opinion seems to be that there is still room for improvement in mining methods on the Rand, and especially that the stoping width could be reduced with advantage to the profit. It is admitted that in some of the Rand mines profits have been sacrificed to the attainment of large tonnage and low working cost. A glaring instance of this is mentioned in an editorial in the *South African Mining Journal* of July 31, 1909, wherein it is said:—

"We recall a case in point, where a thin reef was mined at a certain grade. Instructions were issued that the grade should be reduced by about 25 per cent. . . . . the method adopted for lowering the grade was to mine some additional inches of waste and thus to widen the stope."

This mining of waste of course reduced the working-costs materially, but it must have made a large hole in the profits.

From the above mentioned facts there seems to be some doubt as to Rand mining methods being perfect even when applied in that locality, and still less can they be taken as a criterion for other regions. Hence I can imagine many cases where a less width than 30 inches could be profitably stoped. But what seems to me to be conclusive on this point is that stopes of a less width than 30 inches are advocated by at least one of the Rand engineers, for I find in Truscott's 'Witwatersrand Goldfields,' page 345:

"On the South Reef in the West Rand the miner in charge of a stope which is measured by the sampler to be over 2 feet wide is dismissed."

Truscott goes on to say that the measurements are taken in the face where the width is likely to be less than in the body of the stope, but at the same time there must in many cases be a width of considerably less than 30 inches.

C. S. H. holds that no amount of organization or administration will enable as low a cost to be reached by the employment of coloured as by white labour, for the reason that a large number of white overseers must be employed. I consider that there is such a thing as cheap labour, and that it is likely that the lowest costs will be reached in Eastern Asia. In what follows I refer only to the Chinese and Japanese.

That the Chinese and Japanese have the administrative ability, the tenacity of purpose, and the ambition, which C. S. H. regards as belonging only to the white races, is shown by many recent events. I mention the construction of the Peking-Kalgan Railway, which was built entirely by the Chinese under their own engineers at a less cost than any of the railways constructed in China under European supervision. The masterly handling of the Japanese troops in the Boxer campaign and in the Russo-Japanese war shows that this race possesses administrative qualities of the highest order.

While many Europeans are convinced of their superiority to the Chinese in all points, the latter do not hesitate to compete with the white men in commercial enterprises, and often the victory is with the Chinese. Even now the Chinese are starting coal mines in the Kai Ping basin and hope to produce coal at a less cost than can the Chinese Engineering and Mining Co., and in Honan they are attempting to sell coal at a less price than the Pekin Syndicate.

The majority of Californians would be surprised to learn that the Chinese and Japanese are inferior in administrative ability to the white man, for they have ocular demonstration to the contrary when they see the pork trade of San Francisco in the hands of the Chinese, and when they buy their potatoes at a price fixed by the Japanese 'Potato King.' Hence I am surprised to see C. S. H. contend that white labour is cheaper than the Chinese; the cry of "Chinese cheap labour" must have often resounded in his ears, and he must know that the verdict of all the English-speaking communities facing the Pacific from Australia to Alaska is "the Chinese must go." It hardly seems possible that all these communities can have made an error in thinking that the Chinese and Japanese can work more cheaply than the white man. But what seems final on this point of the cheapness of labour is that the Chinese have already established low-cost records in the important commodities of iron and coal while employing only their native methods, and I look to see lower costs yet when they attain more technical skill.

C. S. H. asks: "When may the mining industry expect the millennium predicted?" That is, when will low mining costs be reached in mines operated by coloured labour? I will point out here that it will be more of a gehenna than a millennium for the white man when the lowest mining costs are reached in Eastern Asia, but giving to 'millennium' the meaning I think C. S. H. intends to give it—that is, the time when European-owned and managed mines operating in foreign lands with workmen of the so-called inferior races attain cheaper costs than do similar mines worked by European miners—I should say that this special millennium will arrive when the white managers of such mines are fully conversant with the language and customs of the country in which they are working.

W. H. SHOCKLEY.

London, November 8.

Labour in Mines.

The Editor:

Sir—Mr. Loring in your last issue quotes a specific case illustrating the excellent results obtained from properly treating white labour in West Australia, and I heartily agree with his view in regard to wages. In another department of your November issue Mr. William Braden refers to the training and sensible handling of natives in Chile. My own experience in Colorado, Australia, and Mexico, dealing with labour of wide variance in ability and intellect, has convinced me that it is the mental attitude of the labourer toward the manager that decides the quantity of productive muscle or brain matter put into the work. Petty and annoying restrictions, while they may theoretically save a few minutes of time, lead to graver lapses of work because the workman feels he has no sympathy with his employer. On the Bischoff mine in Tasmania, during a visit, I found a regulation preventing the men from smoking even in the open-cuts. The manager stated that he saved in this way the time lost by the men in filling and lighting their pipes, but he did not realize that the men were using the conveniences which he had erected, as a smoking annex, and losing much more time than if they had been allowed to smoke while working. A discontented shoveller can use up time even under the direct supervision of a shift-boss, without being detected.

Whether the work is better done by contract or day-labour depends wholly on local conditions. If by contract the least suspicion of irregular measurement will breed discontent more costly to the company than the slight saving made at the time.

The relation between the manager and the staff is of the utmost importance. The most rigid discipline should be enforced, but the members of the staff should be sufficiently in sympathy with their boss to feel that good work will meet with recognition. Too many managers fail to give credit for the assistance they receive from their subordinates. This discourages original ideas; makes the men work on 'whistle time,' and leads to graver omissions. A young engineer of recognized capability was recently dismissed from a South African mine because he talked too much of the company's business on the outside. While admitting that he was in error and deserved his punishment, I believe that it was the fault of his employer. If the young man had respect for, and was in sympathy with, his manager, this would never have occurred. As a rule on large mines, there is too much secretiveness surrounding the General Manager's office, too great a gulf between the head and the next in charge. It is good policy to make the subordinate feel that his superior is coaching him as an understudy, and at the same time retaining his admiration and respect so that he is content to bide his time. It is creditable to a manager if on retirement his former assistant takes the responsibility, and gives equally good, or even better results without a complete revolution in policy.

For a large property a manager should be chosen not for his technical ability alone, but for his keen judgment of men, and his power to make them feel his superiority in executive ability and entire fitness to be their leader.

EDGAR RICKARD.

London, November 28.

Murex Magnetic Process.

The Editor:

Sir—We beg to draw your attention to an alteration that should be made in the notice in your issue of November regarding the Murex process. You say that 1 gal. of a 5% solution of sulphate of alumina is sufficient to cause 30 lbs. of magnetite and 65 lbs. of thick residuum oil to form a mixture inseparable by the magnet, and that this quantity of emulsion is sufficient to treat 2 tons of Broken Hill zinc tailing. This is not our actual practice. In treating Broken Hill ore, which contains roughly 40% of mineral against about 30 to 35% in the case of zinc tailing, we are using an emulsion containing 20 lbs. of thick residuum oil and 60 lbs. of magnetite. You will readily see that this is an important difference, as the quantity of oil we have to use is much less, thus substantially reducing our costs. Instead of having to use, as noted in your paragraph, 32½ lbs. of oil per ton of tailing, we only actually use 20 lbs. per ton of original ore.

For the Murex Magnetic Co., Ltd.,

ARTHUR J. PEGG, Secretary.

[Our reference to the amount of emulsion used and its constitution was obtained from the example given in the patent specification. The ability to reduce the amount of oil in the manner indicated in this letter will reduce the cost of operation of this process.—Editor.]

COMPANY REPORTS

Rio Tinto.—This company, operating the leading copper and pyrite mine in Spain, issues an interim report in the autumn on the occasion of the payment of the half-yearly dividends. These interim reports do not say much about the business of the company, nor, as a matter of fact, do the yearly reports issued in the spring. The present report announces an interim dividend of 30s. per £5 ordinary share as well as the usual half-yearly 2s. 6d. on the 5% preference shares of £5 each. The output of copper and pyrite is reported to be about the same as that of a year ago, but the removal of overburden has considerably exceeded that of previous years. The consumption of pyrite for acid manufacture has been rather slack this year in many quarters, but shows some signs of improvement. No views are expressed as to the prospect of an increase in the consumption of copper or of a rise in price, although in a recent circular the directors of this company expressed sanguine views on the subject.

Lake View Consols.—This mine at Kalgoorlie continues to make a fair profit, though, of course, the ore is of very much lower grade than in the famous boom days of 1899 when this mine produced 30,000 oz. per month. During the year ended June 30, the 70 stamps treated 98,962 tons without amalgamation. The crushed product yielded 9606 tons of concentrate, which was roasted, slimed, and cyanided, yielding 15,854 oz. gold, while the remaining 89,356 tons were ground to slime and cyanided, yielding 10,839 oz. gold. In addition 111,464 tons of old slime was treated yielding 6760 oz. gold; and 232 oz. was recovered from cyanide slags. The total production was therefore 33,865 oz., realizing £145,464. The working cost, including development, was £1. 1s. 3d. per ton; and the recovery, £1. 3s. 3d. The cost of treating the old slime was 2s. 6½d. and the recovery 5s. 2½d. The total expenditure was £119,718, leaving a profit of £25,746. The amount treated in the mill was less than in the previous year, when 129,110 tons were crushed. As regards the future, development during the year has brought to light 91,475 tons additional but no new orebody has been discovered. The total ore reserves on June 30 were 172,050 tons. The company, in addition to operating the mine, conducts also a finance department. It owns 60,675 shares in Broken Hill South Blocks and has a large holding in The Burma Mines Ltd., in addition to shares in several smaller companies. There is a reserve fund in sound investments amounting to £47,000. The interest in Golden Links terminated in April and the ore from this mine is not now being treated at the mills. The total profit made by the company during the year under review was £33,075, out of which £17,479 has been paid as dividend, being at the rate of 5% on the paid-up capital. During the year the company has had a dispute over the price of its water supply. In 1906 the mine was certified as low-grade and entitled to receive water at 3s. 6d. per 1000 gal., but since then attempts have been made by the public authority to rescind the arrangement and to charge 5s., the full rate. This dispute is not yet settled.

Sheba Gold Mining Co.—This company, owning mines at Barberton, Transvaal, did well during the years 1891 to 1898, but has since paid no dividend. In fact in 1904, additional working capital had to be raised by means of reconstruction. During the year ended June 30 last, 96,100 tons were milled, yielding by amalgamation, concentration, and cyaniding, a total of 25,944 oz. gold. The extraction is returned as 87½% of the contents, as compared with 74% a year ago, but the manager, Howard Hill, rightly draws attention to the fact that substantial amounts of rich concentrate were held over from the previous year and consequently made the increase in the extraction this year more apparent than real. About a year ago the directors came to the conclusion that work should be concentrated on one or two parts of the property, instead of scattering the operations. This was accordingly done, and the ore is now being drawn chiefly from the Insimbi and Zwartzkopje. During the year covered by the report the development work did not bring to light any ore over 7 dwt., but since then some important discoveries have been made on the Rosetta property. At the meeting of shareholders held at the end of October, the directors were able to announce that some high-grade ore had been found. At a point only 15 ft. from the surface an assay of 15 dwt. was obtained, and at a depth of 40 ft. the ore assayed 24 dwt. over a width of 54 in. Similar assays have been given at other parts and there seems a good chance of a valuable orebody being developed. The directors were placed in a false position by somebody on the spot sending information about the new discovery to London speculators, who commenced to boom the market before official news was published. The directors told the shareholders at the meeting that they did not care to publish every promising assay, for in the past there have been many disappointments owing to the rich parts being patchy, and they gave a specific warning in the present case that the new discovery must not be magnified into a bonanza.

Simmer & Jack.—This mine is one of the largest on the Rand and is under the control of the Consolidated Gold Fields of South Africa. During the year ended June 30, the ore raised amounted to 955,035 tons, of which 827,500 tons were sent to the mill. The 320-stamp mill crushed 831,040 tons and produced 145,613 oz. The six tube-mills treated 468,450 tons and yielded 60,969 oz. The sand plant treated 560,326 tons by cyanide and produced 66,521 oz., and the slime plant 270,714 tons producing 19,606 oz. The total production was therefore 292,710 oz., valued at £1,233,151, the yield being 7·04 dwt. or £1. 9s. 8d. per ton. The working expenses were £540,537, or 13s. per ton, leaving a profit of £694,186, or 16s. 8½d. per ton. The dividends distributed out of the year's profits totalled £675,000. With regard to mining operations, it is mentioned in the report that of the total ore won, 72% was broken by hand, and 28% was mined by machines. The average stamp-duty was 7·43 tons per day. The number of natives employed was on an average 3658, or 500 less than during the previous year. This decrease is due to greater efficiency, gained by having yearly contracts. It is noteworthy also that only one shift a day is worked in the mine, resulting in a larger tonnage being won with less labour, and a reduction in working cost and increase in the profit. The amount of payable ore developed during the year was 895,732 tons. Owing to the reduction in costs it has been possible to include certain blocks of ore among the payable reserves. The reserves have been re-estimated on the new basis and are now given as 2,500,000 tons of an average assay value of 6½ dwt. During the year under review the assay value of the ore milled was 7·49 dwts. of which 7·04 dwts. was extracted, being a recovery of 94½%. During the previous year the assay value was 8·14 dwts. with an almost identical percentage of extraction. At the same time the cost fell from 16s. 2d. to 13s., and since the end of the financial year the cost has fallen to the extraordinarily low figure of 11s. 10d. C. D. Leslie who has been for some years manager of this mine is about to take up the management of Robinson Deep, and A. R. Stockett who has been acting as manager during Mr. Leslie's recent holiday will succeed him permanently.

For many years the Simmer & Jack, with its 300-head mill, was the Rand's greatest gold producer. Last year the premier position, for single, unamalgamated properties, was gained by the Robinson. The tonnage capacity of the Simmer & Jack has steadily increased and is still increasing (as the result of metallurgical progress in milling practice) but the grade and yield have fallen. Coincident cost reduction has more than balanced the drop in yield per ton. Comparing the years to June 30, 1908, and 1909, the results are as follows:

	1907–8.	1908–9.
Tons milled	785,310	831,040
Total yield	£1,268,826	£1,233,152
Yield per ton	32s. 4d.	29s. 8d.
Cost ,, ,,	16s. 3d.	12s. 4d.
Profit ,, ,,	16s. 1d.	17s. 4d.
Total profit	£631,919	£721,514

In his speech at the annual meeting, the Chairman referred to the satisfactory results obtained with the Caldecott sand-filter table (vacuum-rotary), of which the first experimental unit was erected on the Simmer & Jack, prior to its adoption on a large scale by the Simmer Deep. The small plant on the Simmer & Jack has been collecting 9000 tons per month and increasing the time available for treatment in existing sand vats by 20 per cent.

Consolidated Gold Fields of South Africa.—The report of this company for the year ended June 30 last shows a profit of £1,283,891, the bulk of which has been derived from dividends paid by subsidiary companies. For many years the Simmer & Jack was the great mine connected with this group. More recently Robinson Deep, Knights Deep, and Simmer East joined the older mine as large producers; while within the last year Jupiter and Simmer Deep have started operations on a large scale. The Consolidated Gold Fields, as far as the Rand is concerned, is now depending almost entirely on the yield of its mines for a profit rather than on market operations or development work. The financing of new propositions finds an outlet in other parts of the world, notably Rhodesia and the West Coast of Africa. In the current report reference is made to the investment in Lena Goldfields, the gravel proposition in Siberia, but nothing is said of the various interests recently acquired in the United States and elsewhere. To give some idea of the extent of the Gold Fields' operations on the Rand we may mention that the subsidiary companies Simmer & Jack, Robinson Deep, Knights Deep, Simmer East, Jupiter, Simmer Deep, and Nigel Deep, keep 1350 stamps running, and during the year ended August 31 produced 984,302 oz. of gold. The total stamps in operation on the Rand are 9842, and the yearly production 7,360,915 oz. The Gold Fields group employed 24 tube-mills out of the 144 on the Rand. The tons of ore crushed were 3,224,168 out of 22,033,857, and the stamp duty was 7·38 tons as compared with 6·7 tons, the average over the Rand. The total mining profits of the group were £1,658,966, for the year ended August 31. Out of the profit made by the Gold Fields for the year ended June 30, dividends aggregating 35%, representing £700,000, have been paid on the ordinary shares, as well as 6% on 1,250,000 preference shares and 5½% on £300,000 of debentures. Out of the year's profit £500,000 has been written off for depreciation of the mines, which are thus officially recognized as wasting assets. With regard to the West African investments nothing is said in the report in addition to what is already known. The Rhodesian interests are treated in more detail, and H. A. Piper's report is quoted in full. The interests here include the Giant and Enterprise mines. The first of these still suffers owing to the collapse of the main shaft, and at the latter the New Found Out property is giving fairly promising results. At the Edmundian copper mine progress is slow in consequence of trouble with the stamps and the furnace. The discoveries at Abercorn have induced the Consolidated Exploration & Development of Rhodesia, a Gold Fields subsidiary, to reconstruct, thus introducing £50,000 new capital. The Gold Fields is taking up the Shamva in the Abercorn district, as already reported. Ancient workings were traced along this property for 1500 ft. by the prospectors and developed by a series of shallow shafts and cross-cuts. Since the Gold Fields took up the property additional development has opened out a body of banket 90 ft. wide assaying 12½ dwt. and at another point 30 ft. wide assaying 20 dwt. The labour question is causing the Gold Fields as well as the other South African houses some anxiety. Notwithstanding the increased number of natives now employed and their greater efficiency, due to the longer contracts made, there is still a shortage of labour owing to the great expansion of the industry.

French Rand Gold.—The directors of this company have issued a circular announcing the temporary closing of the mine. The company belongs to the Wernher-Beit group and the property is situated on the western end of the Rand at a point where the country is much broken. During the first half of the current year the mine suffered severely from floods, which disorganized mining and development work, and for some months serious losses were incurred. On recovery from these troubles, the labour supply began to fail, the working force dropping from 1840 in April to 1178 in September. For the past eighteen months the eastern part of the mine has been gradually abandoned and work concentrated at the western portion, where more encouraging results have lately been obtained, and development has been pushed ahead. As much as 1032 ft. of development work was done during September, and the results have pointed to the existence of some unbroken stretches of reef of encouraging value. However with the limited ore reserves and shortness of labour it has been found necessary to alter the policy of the company. One proposition was to stop the mill and prosecute development actively; unfortunately this would require funds and there are none available. As a second alternative it was proposed to stop development and mill all the available reserves; but this plan would leave the mine in a hopeless position for re-opening subsequently. It was finally decided to close down all operations until technical and financial conditions improved. At the end of October the indebtedness of the company was £31,867. By a complete clean-up of the plant and sale of stores the indebtedness will be reduced to £22,000, after discharging outstanding debentures.

Lena Goldfields.—This company has just issued its first annual report, covering the year July 10, 1908, to June 30, 1909. The company was floated by the London Venture Corporation in conjunction with the Consolidated Gold Fields of South Africa and the Consolidated Mines Selection Co. for the purpose of acquiring 70% of the shares of a Russian company called 'The Lenskoie' which has operated since 1863 a number of groups of extensive gold-gravel deposits in the neighbourhood of the Vitim river, a tributary of the Lena. At the time of the flotation 746,830 shares were issued fully paid and 243,128 were subscribed for in cash to provide working capital. Since then 7008 shares have been issued for the purpose of acquiring a further share in the Lenskoie, bringing up the percentage holding to 74%. Also 75,250 more shares have been issued for cash, and a further 50,000 are on option. Some of the recent shares were issued at a premium, a sum of £12,187 being received in this way over and above the par value. In addition to the shares in the Lenskoie, the company has bought the Bodaibo railway, which serves part of the district. The profit of the Lenskoie company for the year ended October 13, 1908, was £325,677, which is £75,000 more than estimated. Out of this profit £177,000 has been devoted to writing off for depreciation and amortization, and £95,747 is carried forward, there being no distribution of dividend. The results for the year ended October 13, 1909, show that approximately the profit has been £400,000, though the exact figures are not yet to hand. The properties belonging to the Lenskoie consist mostly of the gravels of ancient river-beds lying in many cases as much as 100 ft. below the surface, and are worked by drifts. Up to the present time the faces have been thawed by means of charcoal fires, but A. D. Gassaway, a Californian engineer now examining the properties, recommends the introduction of steam-points. The gravels are rich, and C. M. Rolker, the company's consulting engineer, in his report mentions figures varying from 4 to 15 dwt. per cubic yard.

Tasmania.

Mount Lyell Mining & Railway.—An abstract of the report of this company for the half-year ended September 30 has been cabled from Tasmania for publication in London. The total amount of ore smelted during the six months was 190,482 tons, averaging 2·81% copper, 1·98 oz. silver, and 0·6 dwt. gold per ton; of this 124,843 tons came from the Mount Lyell mine and 65,639 from the North Mount Lyell; in addition 499 tons of metal-bearing fluxes and 156 tons of purchased ore was treated. The yield was 4538 tons of blister copper containing 4484 tons of copper, 362,001 oz. silver, and 6489 oz. gold. In addition to the ore smelted, 6922 tons was used in the manufacture of acid. At the beginning of the six months 1088 tons of copper remained unsold. This has since been sold at an average price of £58. 11s. 8d. Of the copper produced during the six months 3189 tons has been sold at an average price of £60. 4s. 4d., leaving 1295 tons unsold on September 30. The net profit for the half-year was £139,850 after allowing £5299 for taxes, £9930 for depreciation, and £18,461 for exploration, and the dividend distributed absorbed £105,000. The amount of ore treated during the half-year was rather less than usual, a decrease due to the interference of the weather with operations in the open-cut. Extensive prospecting work has been conducted in the North Mount Lyell, and the most important development has been the discovery of bornite in payable quantities at the 1100 ft. level. The extent of the orebody has not yet been fully ascertained, but the indications are encouraging. On the higher levels, notably those at 700 ft., 850 ft., and 1000 ft., the orebodies have been found to be of greater extent than originally estimated, and the reserves have been correspondingly increased. The ore reserves on September 30 are reported as follow: Mount Lyell, available by open-cut, 493,232 tons averaging 0·6% copper, 1·93 oz. silver, and 0·5 dwt. gold; the North Mount Lyell, 777,594 tons averaging 6% copper, 1·33 oz. silver, and 0·1 dwt. gold. The reserves at the North mine are 63,658 tons greater than six months ago, and are larger than at any previous period in the history of the mine. The cost of producing blister copper was 15s. 5½d. per ton of ore as compared with 15s. 7½d. per ton during the previous half-year. With regard to prospecting work at other mines, it is reported that the properties in the Norfolk range, though proved to contain copper ore, are too far away from communications to warrant development at present. Prospecting is also being conducted in the Mount Balfour district. The fertilizer works belonging to the company, at Yarraville and Port Adelaide, are in full operation and the demand for fertilizer is so strong in various parts of Australia that a new plant is being erected at Fremantle, West Australia. This branch of the company's business has been a great success and in order to cope with the extra work involved it will be necessary to appoint a special committee of the board.

Nigeria Tin Corporation.—This company has been formed with a capital of £100,000 to acquire and develop alluvial tin areas in Northern Nigeria. It has been founded by Oliver Wethered, who, it will be remembered, was the active spirit in introducing London money for Dolcoath ten years ago. As co-directors in the present board he has a director of Dolcoath, a director of Tronoh, and two directors of Phœnix, so that the board is a strong one in tin. No properties or options have as yet been acquired, but there is plenty of business in view. Nigeria has long been known as a tin country; the natives have washed the gravel and smelted the concentrate. Their so-called 'reed' tin is well known, being in the form of long thin rods. The district where the gravels are found is too far inland for it to have been an attractive spot for English operations, but since the Niger company first took an interest in the subject some seven years ago the extent of the deposits has been more accurately appreciated. The Niger company has done much development in the Naraguta district in the Bauchi province, and in spite of the fact that only native washing appliances have been employed as much as 500 tons of concentrate was exported during 1908. Hitherto the difficulty of transport has stood in the way of active development. At the present time a railway is being built from Baro, a town on the Niger river, toward the Bauchi province, and trains are already running over 100 miles. By next June the total length of 216 miles should be completed. As an instance of the occurrence of these gravels it may be mentioned that a new district is reported where the gravel yields 3 lb. per cu. yd. in the upper wash, with 2 ft. of bottom wash running 10 to 60 lb. per cu. yd. News also is published that a lode rich in tin and copper has recently been found. Of the nominal capital of the company £75,000 is now being issued and the whole of it except the usual preliminary expenses of company formation will be available as working capital.

St. John del Rey.—This company owns the Morro Velho gold mine in Brazil and has the distinction of being the oldest gold mining company registered in England, having been formed originally in 1830. George Chalmers is the superintendent. During the half-year ended August 31, covered by the interim report just issued, 96,021 tons of ore were raised. Of this 4521 was sorted out and 91,500 sent to the 120-stamp mill. The production was bullion realizing £196,005, or £2. 2s. 10d. per ton. Of the yield per ton, £1. 11s. 6d. came from the battery and 11s. 4d. from the 'oxygen' process. The total extraction was 87·15% of the assay-value of the ore. The yield was 3s. 10d. per ton greater than during the previous half-year. The working cost at the mine was £131,949, development £5703, London expenses £1925, taxes and charges £9917. Out of the profits £2729 went to debenture interest, £5292 to the 10% preference shares, and £19,271 to the ordinary shares, being at the rate of 8d. per £1 share for the half-year. In addition £20,709 was transferred to capital account for new works. Since 1901 no less than £201,496 has been transferred from profits to capital account for expenditure on new work, and it is intended to spend at least another £70,000 for the purpose of completing the Peixe electric power-plant and certain adits and a shaft. The directors have decided therefore not to pay off any more of the £77,970 outstanding bonds, but to convert them into second-preference shares bearing interest at 10%. As regards the resources of the Morro Velho mine, it is reported that the lowest or 16th 'horizon' is opening up well, and that above this level the reserves amount to 860,000 tons, or over 4 years' supply. The tube-mill recently provided is still being run experimentally with a view of finding the most suitable lining. One of the most interesting ventures in connection with this company is the installation of an electric furnace for the production of iron and steel direct from the ore. Iron ore is plentiful, but iron and steel have been a serious item of expense to the company. The furnace is giving satisfaction and it is expected that its success will induce the Government to do something to develop the vast resources of iron ore at their disposal,

Jumpers.—The Jumpers is one of the smaller of the original mines at the eastern side of Johannesburg and its separate existence, as may be guessed by the name, was due to errors in the survey of the adjoining claims. For some time its reserves have been known to be limited, and it is owing solely to the re-opening of some of the old stopes that its life has not terminated before now. As it is, there is not much expectation of its operations being continued for more than a year, and then the mine will follow the Bonanza and become a thing of the past. The company was formed in 1887 and crushing started with 10 stamps in 1888. Subsequently the equipment was increased to 100 stamps. During the year ended July 31, covered by the present report, 60 stamps were running and treating 92,960 tons and extracting 30,251 oz. In the cyanide plant 65,545 tons of sand yielded 11,755 oz. and 28,148 tons of slime yielded 3461 oz., all being derived from the current tailing. In addition 36,962 tons of accumulated slime was cyanided, yielding 3991 oz. The assay-value of the ore was 10·38 dwt. and the extraction was 94½%. The total revenue was £208,298, and the expenditure £143,932, leaving a working profit of £64,366. The costs were £1. 10s. 11d. per ton of ore crushed, a high figure which is easily explained by the circumstances of working. As regards ore reserves, it is estimated that there are still 60,000 tons which can be treated at a profit of 10s. per ton, and that 20,000 tons can be picked out of the dump estimated to yield 7s. 6d. per ton profit. There are also 88,000 tons of accumulated slime that are worth treating. A year ago it was announced that the total reserves were only 61,000 tons.

It is clear therefore that the life of the mine has been greatly extended and it is open for the engineers to hope for further discoveries of old stopes worth working. The incentive to thoroughly re-examine the mine was provided by the offer of an underground employee to purchase the mine. If it was worth his while buying it was obvious that there was something there that was not generally known. The profits have not been entirely distributed as dividends, but considerable sums have been used in acquiring interests in the Benoni mine, a small property lying between Van Ryn, Apex, and Kleinfontein. Only £10,000 was distributed as dividend out of last year's profits.

Glynn's Lydenburg.—This mine is situated on the Sabie river in the Lydenburg district of the Transvaal. The report of the company for the year ended July 31 last shows that 31,077 tons were milled and gold worth £88,224 recovered. The total cost was £35,863, leaving a net profit of £52,361, out of which £42,235 has been paid as dividend at the rate of 25%. The 20-stamp mill treated 31,077 tons and produced 7217 oz. fine gold; the sand-plant treated by cyanide 20,542 tons and produced 7821 oz., while the slime-plant extracted 6153 oz. from 10,535 tons. The total yield was at the rate of 56s. 9d. per ton, and the working cost of mining and milling was 19s. 11½d. per ton. The ore reserves on July 31 are given as 71,470 tons, or over two years' supply. The mine and the power-house have been troubled a good deal by floods. The supply of labour has been fairly good, because the natives have suffered from shortness of crops and disease among the cattle and have been forced to earn something by work at the mine. More natives will shortly be required in the Sabie district owing to the increased activity in mining operations, especially at the recently discovered Sandstone Reef. G. C. Damant is manager of the mine and the company belongs to the Wernher-Beit group.

Pilgrim's Rest, Transvaal.

Jumbo Gold.—This mine is situated in the Mazoe valley, 30 miles north of Salisbury, Rhodesia. The company was floated in 1903, when the Charter Trust & Agency and the United Rhodesia Goldfields subscribed the working capital. The Consolidated Gold Fields of South Africa are the consulting engineers, and H. A. Piper and W. F. N. Dudgeon are the individual members of the staff identified with the development of the mine. C. K. Digby Jones is the manager. Milling operations commenced in May 1906, and up to the end of September 1909 the total production has been 60,940 oz. fine gold. During the year ended July 31, the period covered by the report, the 30 stamps crushed 31,520 tons and recovered 12,799 oz. gold. The cyanide plant treated 17,855 tons of sand, which yielded 4922 oz., and 13,547 tons of slime, yielding 2296 oz. By-products yielded 147 oz., thus bringing up the year's production to 20,164 oz. The expenses at the mine were £39,901, the London expenses £1447, and debenture interest £3393. In addition £11,493 was allowed for depreciation, £7881 for redemption of mine development, and £388 for balance of cost of the high-speed engine. The income was £86,893, of which £506 came from rents and the remainder from the sale of gold, leaving a balance of profit of £22,387. The consulting engineers speak encouragingly of developments, and the ore reserves on July 31 are given as 73,336 tons of an average content of 14·47 dwt. The reserves have been more than maintained during the year, though owing to the new ore being of lower grade the average content of the reserves is less than a year ago. The working cost has been reduced by 1s. 9d. per ton during the year, being now £1. 9s. 11·7d. as compared with £1. 11s. 8·7d. a year ago. The mining cost is slightly higher owing to the amount of underground handling required, but this has been more than balanced by a decrease in the milling cost, which has been effected by increasing the weight of the stamps and the speed at which they run. The capital of the company is £340,000, but no dividends have as yet been paid as the profits have been used for paying off the debentures. Of the latter, 252 of £100 each have been redeemed out of last year's profits, leaving £47,000 outstanding.

Bunker Hill and Sullivan.—This "mining and concentrating" company operates one of the great mines of the world, situated at Wardner, in the Coeur d'Alene district, Idaho. Apart from being second only to the Broken Hill Proprietary as a lead-producer, the Bunker Hill and Sullivan is distinguished by the character of its reports, which are models of this kind of financial statement. F. W. Bradley is president and also consulting engineer. Stanly A. Easton is resident manager. D. O. Mills is controlling shareholder. The report for the fiscal year ended on May 31, 1909, is to hand. It contains 29 pages, besides maps of the underground workings. The property covers 2235 acres of patented claims, besides locations, mill-sites, timber-land, and water-rights. During the year under review the operating profit was $1,095,558, but the proportion available for dividends has been heavily reduced by the expense of litigation with the neighbouring company, the Federal Mining & Smelting Co., which has brought three suits based on supposed apex rights that have lain dormant for many years. While title to less than 10% of the ore reserves is involved, it has been deemed imperative to make a most thorough defence, the favourable result of which is anticipated by the management. Reserves developed during the year are in excess of the tonnage mined and the mine is assured of a prosperous future. So says the manager. The production was 341,700 tons of concentrating ore, which was mined at a cost of \$1·55 per ton, and then concentrated for 38·6 cents per ton, yielding 68,008 tons of concentrate. In addition 3514 tons of crude ore, sorted in the mine and mill, were shipped direct to the smelters at Tacoma and San Francisco (Selby plant). Shipping expenses on concentrate and crude ore averaged 22·8 cents per ton. The summary of operations is as follows :—

	Total	Cost per Ton	
		Of ore mined	Of concentrate and shipping ore
Stoping	\$538,363	1·563	7·553
Tramming ...	28,465	0·083	0·399
Concentrating ...	131,677	0·382	1·847
Shipping	16,239	0·047	0·228
Superintendence & Office Expense...	29,446	0·086	0·413
Contingent Expense...	14,182	0·041	0·199
Legal Services ...	3,000	0·008	0·042
Total... ...	\$761,374	2·210	10·681

The gross average value of the concentrate and crude ore was \$44·89 per ton, yielding a total of \$3,199,976, from which freight and treatment charges are deducted to the amount of \$1,343,043, as well as operating costs of \$761,374, leaving \$1,095,558 as the operating profit. Then come deductions for improvements, taxes, exploration, litigation, etc., making in all \$428,807. Finally, after adding sundry receipts, the surplus resulting from the year's operations was \$734,079. Dividends paid during the year aggregated \$825,000, as against \$1,380,000 in 1908, \$2,340,000 in 1907, and \$3,480,000 in 1906. The last was the best year in the life of the company, which was organized in May 1886. In 1908 the balance carried forward was \$166,878 and this year it is \$99,337. The report contains full details of expenditures of every kind and comparative tables highly valuable to the student of mining. No shareholders are better informed concerning their property than those of the Bunker Hill & Sullivan Mining & Concentrating Co. This report is a model.

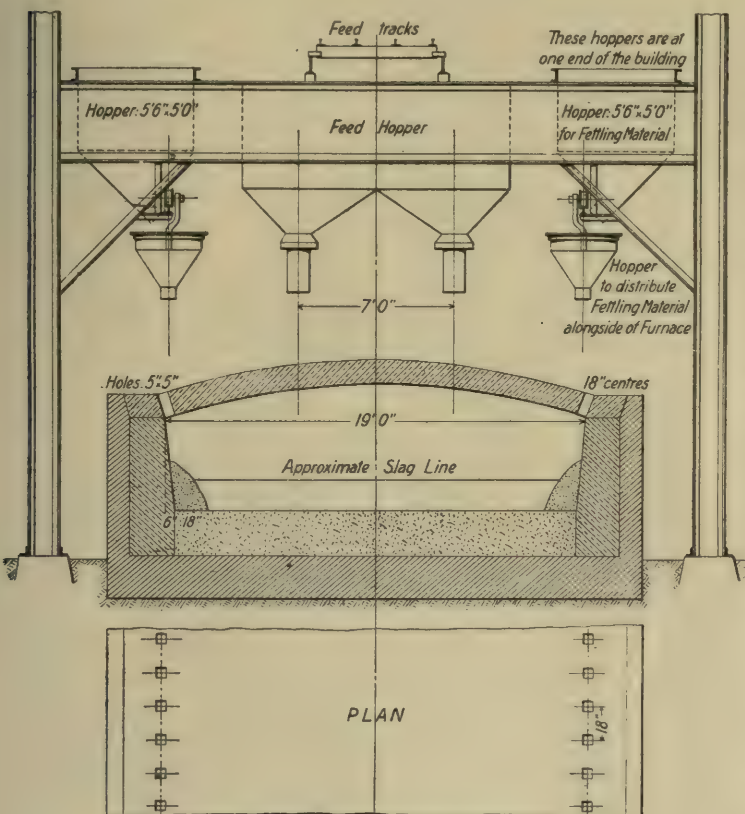
New Found Out Gold Mine.—This company has been formed as a subsidiary of the Enterprise Gold Mining and Estates for the purpose of acquiring and developing the New Found Out mine, which is near the Giant mine in the Hartley district, 68 miles from Salisbury. The Enterprise company is controlled by J. and S. Weil and the Consolidated Gold Fields of South Africa. The latter's consulting engineer in Rhodesia, H. A. Piper, has reported on the property and considers that developments have been carried far enough to warrant the expenditure of £65,000 on equipment, shaft-sinking and development. The formation is the so-called 'banded ironstone,' that is to say ferruginous sandstone, which is heavily mineralized and contains much pyrrhotite and some arsenopyrite. The gold is finely divided and fine grinding will be necessary. Experiments are being made with a view of ascertaining the best metallurgical process of treatment. The developments have been pursued along the ancient workings; sinking and driving to the extent of 3500 ft. have been done. The 70 ft. and 250 ft. levels have been opened up and a third level at 375 ft. has entered payable ore. Though the ore has not been blocked out, Mr. Piper considers that the existence of 33,000 tons valued at 10·6 dwt. per ton may be assumed.

Lancefield.—This company was first formed in 1904 and was reconstructed in 1908. The mine is situated at Laverton, West Australia, and is managed by Bewick, Moreing & Co. At first the ore was free-milling, but it changed rapidly, became complex, and presented serious metallurgical difficulty. Arsenic existed in the pyrite and the ore became very hard. Dry crushing and roasting were adopted, but the presence of the arsenic and the hardness of the rock caused the output of the plant to be much less than was anticipated, and the cost of treatment became correspondingly high, so high as to wipe out the margin of profit. The alternative was to increase the plant, and for this purpose additional capital was required. When the company was reconstructed in March 1908, £30,000 working capital was obtained. Subsequently 100,000 preference shares of 10s. each were created, thus bringing up the nominal capital of the company to £200,000. The report now issued covers the period from April 1908, when the company was reconstructed, to June 30 of this year. Operations both on the surface and underground were suspended in July 1908 and attention was concentrated on the treatment-plant. After a thorough examination of the problem by W. J. Loring, the building of six roasting-furnaces was commenced in December, and in April 1909 three of them were started. A fourth was brought into operation in July of this year, and the remaining two have since been completed. When the equipment is complete the monthly capacity will be 10,000 tons. Underground development was re-started in January of this year and has since that time been continuously and actively pushed. From that date to June 30, 72,065 tons of ore have been developed, bringing the reserve to 165,234 tons containing an average of 34s. per ton, and the main shaft has been sunk to a depth of 665 ft. During the period under review the extraction plant was working part of the time and treated 28,389 tons with a recovery of 9537 oz., which was increased to 9848 oz. by the treatment of slag. The income from this source was £41,880, which was not sufficient by £15,390 to pay for current expenses, exclusive of depreciation, development, or cost of new plant. By the beginning of 1910 it is expected that the mine will be on a paying basis.

Fraser & Chalmers.—The report of this company for the year ended June 30 shows that the net trading profit was £63,561. Salaries, directors' fees, and general expenses amounted to £19,735, the allowance for depreciation was £10,273, and debenture interest absorbed £1105. Interest, dividends, etc., brought the income to £67,199, thus leaving a divisible profit of £36,085, out of which 8% has been paid on the preference shares, absorbing £5040, and 8% on the ordinary shares, absorbing £30,240, a total distribution of £35,280. The profit is rather greater than during the previous year. The directors report that the competition in mining and allied machinery is so keen that profits can only be maintained by an increased turnover. In South Africa the competition is particularly keen, and the prices obtained are low. In order to broaden the scope of the business the company has been increasing the number of its agencies for special machines, and now employs considerable sums for the purpose of carrying suitable stocks of such plant. The value of this company's holding in the Allis-Chalmers Co. has appreciated during the year.

PRECIS OF TECHNOLOGY

Reverberatory Practice at Cananea. — At the November meeting of the Institution of Mining & Metallurgy, Louis D. Ricketts read a paper entitled 'Experiments in Reverberatory Practice at Cananea.' Though these mines are large producers the metallurgical practice was not always of the best. Mr. Ricketts undertook the position of general manager in 1907 and at the same time Charles F. Shelby became metallurgist. A. L. Walker and E. H. Messiter assisted them in consultative capacity in introducing improvements. The present paper gives a general account of the reverberatory furnace erected for the treatment of flue-dust and fine concentrate, and it gives details of the experiments with coal and oil as fuel, the methods adopted for making and preserving the lining, and the utilization of the waste gases for making steam.



Reverberatory Furnace used at Cananea.

The reverberatory measures 100 ft. by 19 ft. and is of much the same pattern as those at Anaconda. McDougal furnaces are used for roasting the fine; they were designed in the old days when there was an expectation of more work for them than under the improved scheme, consequently the capacity is too great, and the present costs are greater than they otherwise would be. In designing the furnace the limited accommodation caused trouble, and it was found necessary to erect the boilers (for using the waste gases as fuel) at some distance from the furnace. The flue carrying these gases has a cross-section of only 27 sq. ft., but there is no more space to build a bigger one, though 50 sq. ft. would be better. When the furnace was originally built, trouble was experienced in finding a suitable lining. Finally, a quartzite from Colorado running 95% SiO_2 was adopted with such satisfactory results that it has never been changed. Mr. Ricketts started the furnace on February 1, 1907, and it ran for 248 days, treating on the average 122 tons of charge per day. The total amount of charge smelted during the period was made up of 28,999 tons of flue-dust, 821 tons of fine, and 415 tons of limestone. The coal available was of poor quality and did not give sufficient heat, consequently the output of the furnace was low. Subsequently experiments were made with pulverized coal. Though more heat was thus obtained and a longer flame, there were drawbacks, such as the difficulty of regulating the draft to ensure complete combustion, and the clogging of the flue with ash, so preventing the use of the waste gases in the boilers. The works of the Cananea company were closed down for a short time in October 1907, and during the interval of idleness enquiries were made relating to oil as fuel. The import duty into Mexico had hitherto precluded consideration of this source of heat, but negotiations with the Government made it possible to introduce Oklahoma residual oil. This has a specific gravity of 0·9 and contains 19,400 to 19,700 B.T.U. per lb. Operations were resumed in July 1908 and at first Hammel's locomotive oil-burners were used. For five months the daily amount of charge treated was 209 tons. Later a burner designed by Mr. Shelby was substituted and it was found more advantageous, as it threw the flame more to the front of the furnace. Four of these burners are in use.

The author gives the figures for operations during the first six months of 1909. The furnace treated 29,802 tons of flue-dust, 5484 tons of roasted fine, 2300 tons of silicious ore, and 3129 tons of flux, or 245 tons per day, and produced 10,120 tons of matte. The amount of copper in the charge was 7·08% and in the matte 30·57%. The percentage of recovery of the copper was 96·04 and the average content of copper in the slag was 0·45%. The oil consumption during the period was 39,417 barrels (a barrel contains 42 U.S. gals). Of this 21,946 bbl. were charged to smelting and 17,471 to steam-raising. The number of gallons of water evaporated was 9,883,493, and the average boiler horse-power was 664. The actual amount of water evaporated per pound of oil burned in the furnace was 6·74 lb., as compared with 13·96 lb. evaporated in the main power-house, where the oil is burned direct underneath the boilers. The cost of smelting was \$2·53 per ton, but owing to the economy in the use of the waste gases this cost was reduced by 77 cents, to \$1·76. Of the cost, \$1·73 represented the consumption of oil; 40 c., the labour of operation and repair; 22 c., supplies; and 18 c., fluxes and miscellaneous.

The accompanying illustration shows the method of fettling the furnace in order to protect the side walls from corrosion at the matte line. The side walls are built at a slight batter, and two series of holes 5 in. square and 18 in. apart are made one on each side of the arch of the furnace. Hoppers travel one on each side and can be made to discharge into the holes. They are charged with fine silicious ore previously dampened. Every day this material is dropped through the holes and it builds up a bank against the slag line. It is then gently tamped down with an iron bar. The holes are at other times kept closed with fire-brick and covered with fine ore so as to prevent access of air to the furnace. In this way it is not necessary to stop the furnace during fettling, and another advantage is that the fine silicious ore is smelted more easily here than in the blast-furnace. Improvements have also been introduced recently into the method of constructing the arch. At first the oil-burners kept burning out the arch and on several occasions the arch had to be entirely re-built. It is the author's intention to substitute 20 in. bricks for the present 12 in., and further experiment will be necessary to prevent the flames impinging on the arch. This trouble with the arch naturally had an effect on costs. The author is also of opinion that a greater saving of waste heat can be effected by the use of fuel-economizers. As it is, the gases are discharged from the boiler-stack at a temperature of 750°F and their further cooling in economizers would substantially reduce costs. There is a probability also that a smaller proportion of fine ore will be treated in the blast-furnaces, thus decreasing the amount of flue-dust. Instead, more fine will be sent to the McDougal roasters. As the roasted fine is easier melted than flue-dust, the efficiency of the reverberatory will be increased by the substitution of roasted fine and flue-dust. It is probable that by these various improvements the cost will be reduced from \$1·77 to \$1·40. The paper generally is one of great interest as a record of difficulties overcome.

Mercury in Peru.—In the *Mining & Scientific Press* for October 23, Lester W. Strauss gives a historical account of the mercury deposits in the district of Huancavelica, Peru. These deposits were worked from the year 1571 onward, and provided the Spanish government with the mercury used in the silver mines. From this year until 1813 the total production is estimated to have been 110 million pounds. Then came the severance of the country from Spanish rule, and ever since, the production has been irregular and limited. In fact, the work in the days of Spanish dominion was done by men who were practically slaves; under free labour the mines could not pay with the crude method of smelting and the great distance from centres of communication. In addition, the development of mercury deposits in Spain and California had an adverse influence on those in Peru. The mines are situated 12,000 to 13,000 ft. above the sea, 160 miles southeast of Lima. The cinnabar belt extends for 40 miles in a northwest and southeast direction. The mineral is found chiefly in sandstone, but also in fractures and cavities in limestone, and to a smaller extent is calcareous conglomerate. There are also intrusions of igneous rocks in the belt, but they contain no cinnabar. Native mercury, due to the reduction of the cinnabar by acid waters, is also found, and there is usually some galena, blende, pyrite, arsenopyrite, and realgar. The average content of the sandstone is about 2% of mercury. The furnaces are of the crudest description, consisting practically of an agglomeration of earthenware bowls, and the fuel used is straw and llama dung. The losses must have always been considerable, due to the escape of mercurial vapour and to the poor quality of the fuel, which does not give sufficient heat to ensure complete distillation. At the present time the production over the whole belt is only 200 to 300 lb. per month. There is some possibility of the Central Railroad of Peru, a northern extension of which serves Cerro de Pasco, being continued in a southerly direction; in which case there may be a possibility of the deposits being worked in a modern manner.

Practical Instruction at Schools of Mines.—The question as to the scale of operations to be adopted in laboratory courses at mining schools readily gives rise to debate, and opinions vary widely, some professors and governors considering that experiments on pound lots are sufficient to teach principles, while others rush to the opposite extreme and demand full working plants as large as that at Anaconda. Besides these differences in personal views, the funds available and the propinquity to large ore supplies have a bearing on the subject. In this connection it is of interest to read the paper of F. W. Traphagen, professor of metallurgy, on the proposed new equipment at the Colorado School of Mines, and published in the October issue of the *Western Chemist & Metallurgist*. Until six years ago, when the present administration assumed control, the equipment for metallurgical and ore-dressing work was meagre in the extreme, and steps were at once taken to make a better provision. The smale-scale equipment was improved as far as possible and a commercial ore-testing plant in the neighbourhood was leased for a few months every spring. Subsequently various mills and mines were leased and the operations conducted by the students. It was still felt, however, that this was not sufficient; the small plant was good enough for teaching elements, and the mines and mills might give confidence to the students in connection with practical operations. But these operations were restricted to the particular purpose of each mill and the available plant, though on a practical scale, was not sufficiently elastic for the purposes of instruction and investigation. In their work the students did not have the advantage of getting into touch with men of wide experience. It was decided eventually to lay down a working plant that would be sufficiently like the plant used in metallurgical practice not only to instruct the students but to attract specialists desirous of working out problems of their own. The school would in this way have the advantage of the company of experienced men, who in return for the facilities afforded them would mix with the students and introduce an air of reality into the investigations and practice. A grant having been obtained from the Colorado legislature, plans were drawn and a description circulated among mining engineers and metallurgists throughout the country, who were invited to offer suggestions and propose modifications. This plan and description formed the basis of Mr. Traphagen's paper. The scheme embraces crushing plant, samplers, stamp-mills, concentrators, cyanide plant, and smelters. There are 12 storage-bins each of 25 tons capacity. The crushing unit consists of a 7 by 10 in. Blake and a No. 2 McCully gyratory breaker. The sampling-house contains machines of the Vezin, Brunton, and Snyder types, together with the requisite accessory apparatus. In the stamp-mill annex there is an 850 lb. 5-stamp battery, and two Nissen stamps. Re-grinding machines include a Huntington mill, Chilean mill, rolls, and ball-mill. In the concentrator there are the usual jigs and classifiers, and a great variety of tables, including the Wilfley, Card, Overstrom, Deister, and others; also dry concentrating machines, including the Wetherill, Dings, Blake-Morscher, Behrend, and Sutton & Steele. The cyanide plant includes tube-mills, Butters, Moore, and Burt filters, and slime separators. The smelter consists of a hand reverberatory, 9 by 4 ft., and a blast-furnace, 18 by 36 in. The latter is provided with a movable hearth, which can be exchanged for a crucible, so that the furnace can be used for either copper or lead. The above is a mere outline of the resources of the new school, but will serve to show the possibilities for such an institution at a great mining centre.

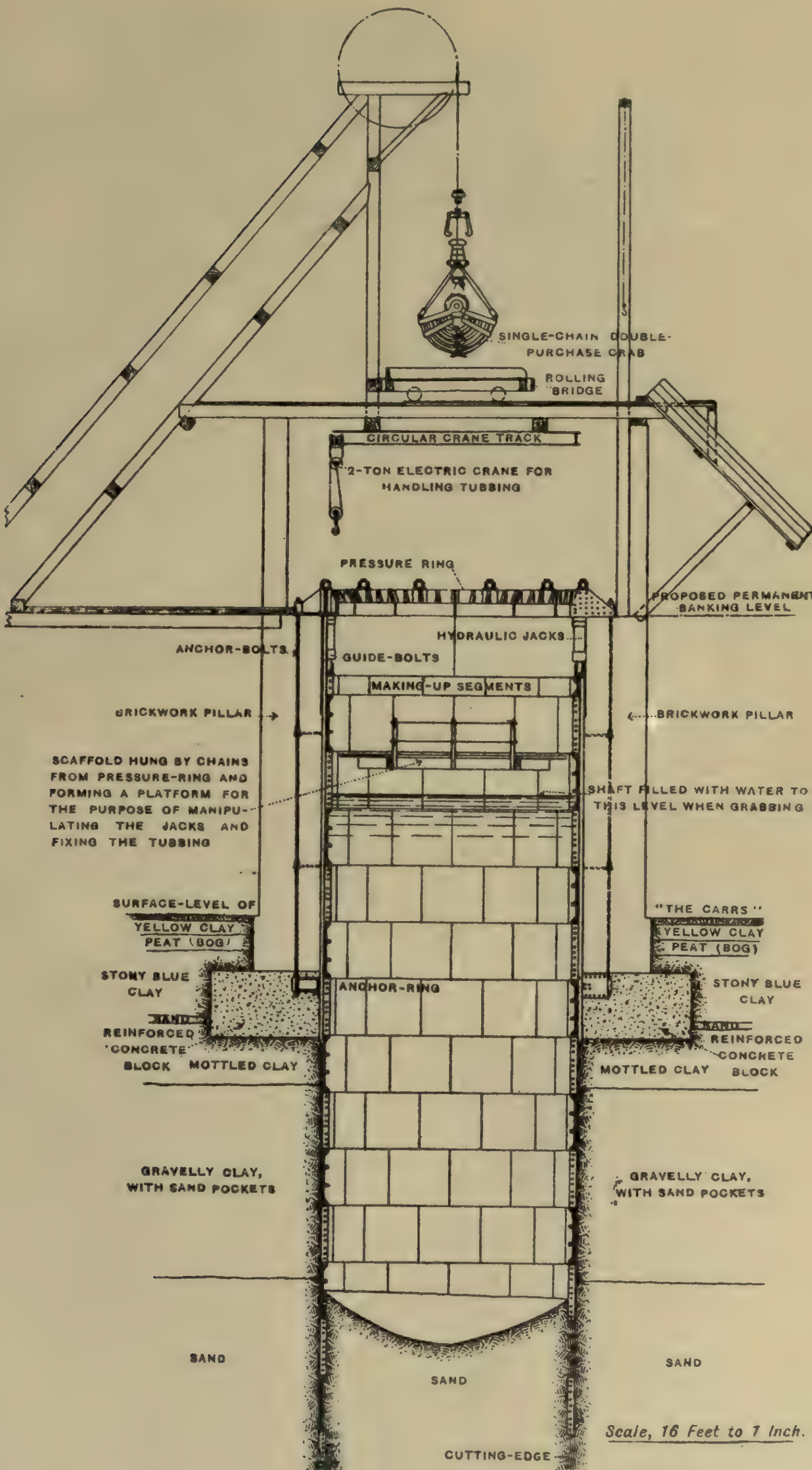
Borax Deposits.—Charles R. Keyes has contributed two papers on the recent discoveries of borax in California and Nevada, one, dealing chiefly with the geology, to the *Bulletin* of the American Institute for

October, and the other, written from a commercial standpoint, to the *Engineering & Mining Journal* of October 23. These discoveries have revolutionized the methods of production of borax and boracic acid. Hitherto these products have been extracted by leaching from old lake-beds, but they are now obtained almost entirely by mining operations, a change due to the recent discovery of immense tracts of clay containing colemanite, that is, borate of lime. The districts where this clay is found are in the valleys between the Grapevine, Funeral, and Panamint mountains, in California near the border of Nevada. This district is perhaps most easily recognizable to the English reader under the general name of Death Valley. Similar clay is also found in the Mojave desert, where it is worked in the neighbourhood of Daggett, the former centre of lake-bed production; and in valleys in the Santa Clara district nearer the coast. At the present time the chief operations are in Furnace canyon on the east side of Death Valley, and in the Santa Clara district between the Sierra Madre and the coast, but in other localities even more important deposits have been found. The map shows the topography of the country between Death Valley and the Pacific, and gives the boundaries of the boraciferous clays. The geological formation of the country consists of Tertiary sandstones and clays with numerous basaltic interbeddings. In the upper portions of these deposits the clays occur. They are fine, alkaline, and of blue and olive-green colour, weathering to pale yellow and white. In addition to basaltic interbeddings, there are also layers of clay containing colemanite, and beds of gypsum, limestone, and rock salt. The richer boraciferous beds vary in thickness from a few inches to 40 ft. In the unweathered portions they consist of bluish clay thickly interspersed with milk-white crystallized colemanite in thin layers and in nodules of varying size. There are also numerous other beds of clay impregnated with fine particles of borates, but of lower content than those above-mentioned; these are being left untouched at present. In many cases the colemanite is mixed with selenite and is almost obscured thereby. Mr. Keyes mentions a deposit as yet unworked where the bed is 50 ft. thick, composed entirely of crystallized colemanite, and extending for several square miles. A square mile will contain a hundred million tons, a truly prodigous figure. The sandstone and clay beds in this district are greatly contorted. In the Death Valley region they are nearly level and the deposits can be worked by adits, but in the Mojave desert and in the valleys of the Santa Clara district the beds are almost vertical.

Heavy Stamps.—In our issue for September we gave an abstract of W. A. Caldecott's paper, on heavy gravitation stamps, read before the Institution of Mining and Metallurgy in October. The discussion on the paper at this meeting was excellent. S. J. Truscott pointed out that the heavier stamp did not increase the efficiency as far as cost of power was concerned, but only increased the capacity. The advantage gained was not any decrease in the actual cost of crushing, but in having larger units and consequent decreased general expenses. He analysed Mr. Caldecott's tables, which give figures for the increased duties as the stamps increase in weight, and, assuming that this increase in the weight meant a corresponding increase in power consumed, he pointed out that the figures showed, if anything, a slight fall in efficiency. The figures for the increased duty did not increase regularly; sometimes the increase was more than the increase in the weight of the stamp would lead us to expect, and sometimes less. On looking through the figures for the amount of water used in the various tests, it was noticeable that where the amount of water was greatest the actual figures for stamp-duty were higher than the theoretical, and where it was the least, the stamp-duty was less than would be expected. Thus it was seen that the amount of water had a decided influence on the efficiency. Mr. Truscott also pointed out that the grading analyses in Mr. Caldecott's tables of results showed varying amounts of the larger grade; in fact, where the stamp-duties were highest it was noticeable that the comparative amounts of coarse were greatest. These two points raised by Mr. Truscott go to prove once more that the efficiency of a mill depends on a combination of a number of factors. H. S. Denny followed; he asked for information on specific points in order that a full comparison of economy could be made, namely: (1) the comparative capital cost of installations with light and heavy stamps required to reduce a specified amount of ore to a specified fineness, (2) the amount of power required per ton of ore crushed, together with a grading analysis of the pulp produced, (3) comparative data of time and labour occupied in carrying out repairs, (4) comparative losses of time in making such repairs. Mr. Denny also discussed the question of preliminary fine crushing, and advocated its application on stamps of ordinary or light weight. He quoted his experience in maintaining the tonnage in a stamp-mill during the time that the plant was gradually being overhauled; by adding fine crushers to reduce the ore from 2½ to 1½ in. the duty of the stamps was increased from 5 to 5·6 tons per day, and the total output maintained at the usual rate although some part of the installation was out of action. This case deserved more mention than Mr. Denny gave to it; in fact, he did not even mention the name of the mine. A more detailed record of the work would be of definite value. R. E. Commans considered that 2000 lb. was about the limiting weight that could be conveniently lifted by cams, and that if any further increase was made a different lifting mechanism would have to be adopted. He referred to Morison's high-speed stamp, which was tried at the Meyer & Charlton, and expressed his surprise that it had not been adopted—a surprise that is shared by most people. Other speakers referred to the advisability of increasing the width of the shoes and dies, and recommendations were made relating to the Holman air-cushion stamp, and to electro-pneumatic lifters built on the principle of the Temple drill.

Shaft-sinking through Sand.—In a paper read a the September meeting of the North of England Institute of Mining & Mechanical Engineers, E. M. Bainbridge and W. M. Redfearn give their experience with the Haniel & Lueg system of sinking shafts through sand and clay at the Newbiggin colliery, Northumberland, 15 miles north of Newcastle. The land is moor and bog, and is close to the sea-shore. Preliminary borings showed the presence of peat bogs below layers of clay. Finally a spot was chosen for sinking the two new shafts, about half a mile from the sea and where the peat-bog was not much more than a foot thick. The boring at this point showed the following strata: surface soil, 6 in.; yellow clay, 15 in.; peat bog, 15 in.; blue clay with stones, 5 ft. 6 in.; sand, 6 in., mottled clay, 5 ft., strong sandy blue clay with stones, 17 ft.; coarse sand full of water, 19 ft.; below this came a soft sandstone. It was soon found that ordinary methods of shaft-sinking were useless, and after enquiry it was decided to adopt the Haniel & Lueg method. We give details of the operations on the first shaft sunk. The shaft was to be 20 ft. circular. A space 40 ft. square was first excavated, and a reinforced concrete structure built up to fill the space to a depth of 6 ft., with a central aperture with the same diameter as the intended shaft. An anchor-ring consisting of stout iron segments bolted together was embedded in the concrete structure during construction, as were also anchor-bolts which extended upward. After the completion of this structure, brick walls were built on top, 30 ft. high and 6 ft. thick, with the above-mentioned bolts embedded in them. On top of this wall was placed the pressure-ring, made in segments similar to the anchor-ring, and the anchor-bolts fastened to it. On the under side of the pressure-ring, near its periphery, were attached ten hydraulic jacks. There were also guide-bolts fixed between the anchor-ring and the pressure-ring for the purpose of directing the action of the jacks. The rams of the jacks worked adjustably on the top of the segments of tubbing. Below the first segment was placed the cutting shoe, which consists of 12 segments of cast steel 2¼ in. thick and 3 ft. 3 in. deep, the lower circular edge being bevelled at 45°. Around three sides of the brickwork that supported the pressure-ring was built another but thinner wall to support a circular track for a crane used in handling the tubbing, and timbers were erected for supporting the headgear of the excavator. A scaffold was also hung from the pressure-ring to accommodate the men supervising the work of the rams and the placing of the tubbing. When work was commenced the shoe was placed upon planks at the bottom of the circular hole in the middle of the concrete block and the necessary connections were made. The planks were then withdrawn, and the cutting edge, being released, began to sink by its own weight for a depth of 10 ft. Pressure was applied to sink the shoe further and the tubbing was gradually built in. Until the sand was reached the excavation was carried out in the usual manner, but at this point water came in and filled the shaft to a level of 10 ft. above the surface of the ground. It was then decided to use a grab for removing the sand. When the shoe had passed through the sand and came to the heavy blue clay some difficulties were encountered. The ten jacks at 5 tons pressure each were hardly sufficient to force the shoe downward, and the grab was ineffective as an excavator. Eventually the brickwork pillar gaped slightly, showing that the strength of the structure between the concrete block, anchor-ring, bolts, and pressure-ring was not sufficient to withstand the strain when the jacks could not force the cutting shoe downward through the heavy clay. Modifications were then made by adding further bolts and by heaping sand and clay on top of the concrete block; also by altering the position of the jacks to bring them adjacent to the bolts instead of equidistant between each two. Instead of using the grab, the shaft was unwatered and men set to excavate. The latter was soon found to be a mistake, as inrushes of water kept taking place, and finally the grab was brought back. The operations went on slowly, but, eventually, three months after starting, the sandstone was reached at a depth of 76 ft. Owing to the greater bogginess of the land on one side of the operations the structure had gradually subsided, and the tubbing had not been sunk perfectly vertical, but the deviation was trifling. Work at the bottom was completed by cutting the stone away to a depth of 16 ft. below the sand, setting a curb on the level floor of the rock, bolting a matching piece to the curb and to the cutting-shoe, and filling the back between the curb and the rock with concrete. When sinking the second pit provision was made to strengthen the structure. The concrete block was made 50 ft. square instead of 40 ft. and the brickwork pillar made stronger on the side farthest away from the bog; also the anchor-ring was embedded at the bottom of the concrete block instead of near the top.

Huff Process.—In *The Mining World* (Chicago) for November 6 there is a short account by S. F. McGregor, of the United States Smelting Co., of the application of the Huff electro-static process for concentrating zinc middling as adopted by the United States Smelting Co., at Bingham, Utah. The Huff process has not been described in detail in any publication, and is not even mentioned in Gunther's book recently issued. There is a short notice in Richards' new volumes, though little information is given. The machine has been in operation for the last 18 months at Platteville, Wisconsin, where a 100-ton plant has been at work on zinc middling. The United States Smelting Co. smelts lead products from Bingham and vicinity, some coming from its own mines and some being custom ore. The company's own ore consists of galena with blende and iron pyrite. Hitherto the dressing plant has produced a lead-pyrite product high in zinc and a tailing carrying zinc in uncommercial quantities. In the latest dressing arrangement a middling is obtained containing most of the zinc and averaging 28% zinc,



Shaft-sinking in Sand.

1·5% copper, 5 to 6% lead, and 18% iron. This product is treated in the Huff concentrator, where a separation is effected between the blende and the remaining constituents. The blende concentrate averages quite 50% zinc. It is shipped for treatment at the smelters belonging to the American Zinc, Lead, and Smelting Co., at Caney, Kansas. The pyrite-galena material removed by the concentrator is low in zinc and is suitable for smelting. The Huff plant is placed in a 3-storey building measuring 40 ft. square. On the ground floor is a dryer of the cylindrical type through which the middling passes to be dried. Thence it is carried by elevators to the top of the building, where it is screened to three sizes, one from 12 to 24 mesh, a second from 24 to 60, and the third smaller than 60. Any oversize from No. 1 is sufficiently low in zinc to be added to the pyrite-lead concentrate. Each size is subsequently re-elevated to the top floor to be passed through the Huff separators. There is a certain amount of middling produced and this is treated over again. As the elevators and concentrators are enclosed, and as the delivery of the material elsewhere is effected through pipes, little dust escapes into the atmosphere, and so far as experience has gone there are none of the objectionable results usually connected with dry processes. The success of this process at Bingham and Platteville seems to warrant the publication of additional particulars, which we hope will be forthcoming before long.

Smelting at Garfield.—In the *Mining and Scientific Press* for October 30, L. S. Austin gives his impressions of recent improvements at the Garfield copper smelter belonging to the American Smelting & Refining Co. Mr. Austin visited this plant in 1905, during the course cf erection, and again in 1907, while the metallurgists were still struggling with various defects inherent to the starting of new reduction works. His latest visit was in September of this year, when he found a number of interesting improvements in working order. One of the noteworthy points is that sintering by pot-roasting has been abandoned and that the fine is now entirely treated in reverberatories. The ore is carefully screened, and nothing less than ⅜-in. pieces are sent to the blast-furnaces, the remainder going to reverberatories. Much less flue-dust is formed in the blast-furnaces than formerly, and a furnace 4 by 20 ft. at the tuyeres will put through from 550 to 600 tons of charge per day, a rate per square foot of hearth-area that exceeds that at any similar plant elsewhere. Another improvement relates to the method of charging the blast-furnaces. Until recently the charge dropped at least 12 ft. and so tended to pack and produce fine and dust. At the present time inclined-bottom hoppers are provided on each side of the furnace. These are as long as the furnace and can be drawn up and down. The charge slides down them and is distributed evenly and without jar. Alterations have been made in the flue systems whereby the converter-fume is lead to an independent stack and does not now interfere with the draft in the reverberatories. Perhaps the most notable innovation has been the adoption of a basic lining for the converters, on the principle originally introduced by Brown & Smith of Baltimore. By means of a basic lining the exact amount of silica required by the charge can be added in the form of silicious ore, and the converting process is thus brought to the point of scientific precision, instead of the treatment of charges of varying composition, the determination of which can only be judged by personal observation. The converters at Garfield are of the barrel type with a shell 22 to 24 ft. long by 10 ft. diam. They are lined with magnesia brick 18 in. thick at the bottom and 9 in. thick above. The spout for the escaping gases is near one end. Their rate of emission is not high and few particles of solid go with them ; in fact, their escape is so quiet in comparison with other plants as to suggest at first sight a slow working of the furnace. There is also a spout and tap-hole plugged with clay for the pouring of slag. The tuyeres, 7 in. apart, extend the whole length of the shell. As much as 2000 tons of copper has been produced with one lining.

Metallurgical Chemistry of Zinc.—The recent proposals for smelting zinc ores in the electric furnace have stimulated interest in the chemistry of zinc compounds at high temperatures, the lack of any such knowledge having seriously retarded the development of the older retort process, which stands today much the same as it was in the middle of the last century. In an important memoir by V. Lepiarczyk (*Metallurgie*, July 1909) the results of a systematic examination of materials occurring in zinc-works practice are set forth and the results obtained are here condensed. He concludes that during roasting, Fe_2O_3 hinders the oxidation of blende, and CaS, by forming $CaSO_4$, prevents the reduction of the sulphur content, causing greater loss during the subsequent reduction. Lime and carbon inter-act according to the following equations :

$$CaSO_4 + 4C = CaS + 4CO$$

$$3CaSO_4 + CaS = 4CaO + 4SO_2$$

the latter being hitherto unsuspected. ZnS and FeS are reduced directly by carbon, possibly in this manner :

$$2ZnS \text{ (or } FeS) + C = 2Zn \text{ (Fe)} + CS_2$$

At 800° C, ZnO is slightly volatilized and completely above 1300° C. Unroasted blende is reduced by ferric oxide :

$$2Fe_2O_3 + 4ZnS = 3FeS + Fe + 4ZnO + SO_2$$

ZnO reacts with Fe, Ca, and Mn sulphides and sulphates. As practical applications we see that Fe_2O_3 is bad when present during roasting but it attacks unoxidixed blende during distillation and that in lime-bearing ores it may give a higher extraction. An increased extraction is not to be expected from a decreased sulphide content of the roasted ore as long as the formation of sulphate is not prevented. In these researches there has been an unaccountable loss of Zn and sulphur and this is tentatively explained by the formation of a new compound ZnCS or possibly $ZnFe(CS)_2$ though no evidence has been found for confirming the existence of either form.

In a later copy of *Metallurgie* (Nov. 1909) W. Fraenckel describes experiments made to test the above explanation. A mixture of 90% ZnS and 10% carbon heated in nitrogen to 1300° C was found to be completely volatilized, the escaping current of nitrogen having a smell not unlike that of CS_2 and from the cooler part of the combustion-tube a solid was isolated having a composition corresponding to the formula ZnSiS, the silica having been obtained from the silica combustion-tube. It is probable that this compound is formed in the zinc-retorts causing a loss of zinc hitherto unexplainable.

Barite at High Temperature.—An exhaustive research carried out at Charlottenburg on this subject is described in *Metallurgie* (July 1909) by W. Mostowitsch. (1) Pure $BaSO_4$ decomposes at 1500° C into BaO and SO_3 and melts at 1580° into a mixture of BaO and $BaSO_4$. It is unchanged at 1000° C. (2) In the presence of SiO_2 it is decomposed even at 1000° C without however forming definite compounds, the silicates of barium dissolving BaO and $BaSO_4$ readily. The same result is obtained with Fe_2O_3 though not to such a marked degree. (3) At 600° C it is easily reduced to Ba S by carbon or C O, the action being complete at 800° C, and the Ba S oxidizes at 1200° C without melting. These results can be applied to the practical roasting process shewing the reasons for well established observations on the presence of barite in ores which have to be roasted. Thus barite does not enter into the reactions till 1000° C at which temperature it is slagged by silica and ferric oxide. This decomposition being strongly endothermic cools the charge and so lengthens the period of roasting. In blende ores it remains unchanged but during the subsequent reduction by carbon all the $BaSO_4$ has been reduced at 800° C at which temperature the Zn O commences to be decomposed so that more carbon is required. In blast furnaces it behaves mostly as a slag-forming constituent, often being present in the slag as $BaSO_4$, though in exceptional cases it may enter the matte.

Influence of Nickel on Copper.—The results of replacing arsenic by nickel in commercial copper are discussed by Dr. W. Stahl in *Metallurgie* (Oct. 8, 1909). Users demand that copper for plates shall have a tensile strength of 14 tons per sq. in., elongation 38% and contraction 50%, while for wire and bar copper, a tensile strength of 15 tons, an elongation 38%, and contraction 45% are desired and so the necessity arises of adding an alloying metal to enable these figures to be attained. Arsenic increase the strength up to 0·30–0·35% As, without affecting the elongation; above that the strength still increases but at the expense of decreased elongation. Average figures for this percentage are: tensile strength, 14–15 tons per sq. in.; 33–44%, elongation; 47–62%, contraction. It increases the working properties and also prevents the prejudicial effects of small quantities of bismuth and other impurities in the copper. Nickel behaves in copper similarly as in iron, increasing the tensile strength without affecting the other properties, and also tending to prevent segregations. The average of a large number of experiments on the influence of several tenths per cent. of nickel gives tensile strength 14–15 tons, elongation 39–46%, and contraction 50–67%. After many years experience in the manufacture of nickeliferous copper the author has decided that nickel has a similar effect to arsenic in copper, but it withstands better the effects of work and large temperature variations.

Rand Yield of Gold.—In the *South African Mining Journal* for September 25, there is presented a statistical table relating to the growth of the Rand from 1887 to the end of 1908. The tons milled, yield per ton, working costs, dividends, and rate of extraction are all worked out. During the years 1887-8-9, 850,000 tons assaying 88s. per ton yielded 53s. per ton, an extraction of only 60%. Year by year the assay-value of the ore has decreased, until in 1908 the output, 18,196,589 tons, averaged only 33·6s. At the same time the rate of extraction has gradually increased until the figure is now 94%, and the yield has gradually dropped to 31s. per ton. The working cost has dropped from 40s. in 1889 to 22¼s. in 1908. The dividends, expressed in shillings per ton, have not shown wide variation, though they have been jerky. The highest rate was in 1898, when the figure was 13·22s., and the lowest in 1891, when it was 5·69s. During the five years 1904 to 1908 the rates assumed a more steady tone, and were 9·58, 8·51, 8·20, 8·92, and 9·38 shillings. In calculating these results the costs are taken as the difference between the yield and the dividends. The ratio between the dividend per ton and the yield per ton is steadily increasing. In 1908 it was 3·4 : 1 as compared with 4·2 : 1 in 1905. That is to say, 9·38s. per ton was distributed out of a yield of 31·66s. during 1908, as compared with 8·51s. out of 35·8s. in 1905. As regards the future, the total yield will increase, but the yield per ton will decrease. The cost will also decrease and the percentage extraction will remain pretty much at the present figure.

Tellurides. — In *Economic Geology* for October, Victor Lenher contributes 'Some Observations on the Tellurides.' He has collected the few facts known concerning these interesting minerals and has added results of experiments made by himself. Although the tellurides are of little use for industrial or metallurgical purposes, they are important by reason of their association with ore deposits rich in the precious metals. Native tellurium is credited to Boulder county and to Cripple Creek, Colorado; the latter part of this statement is open to doubt, the most notable recent find of this metallic element should be credited to Vulcan, in Gunnison county, Colorado. Calaverite (named after the county of Calaveras, in California), and krennerite (after its discoverer Krenner) are the tellurides richest in gold. It is obvious that Mr. Lenher has not examined many specimens of calaverite from Kalgoorlie, otherwise he would not describe the mineral as "silver white or slightly bronze coloured." The West Australian calaverite is a rich lustrous yellow. When pure it contains 44% gold and 56% tellurium. Hessite is the silver telluride; good specimens have come from the La Plata mountains (Colorado), as well as from Nagyag and Veraspatak, in Transylvania. The lead tellurides altaite and nagyagite are named after the localities where they were first found, but they have an academic interest only. The telluride of mercury is coloradoite and it is allied to kalgoorlite, which is a West Australian variety containing gold and silver. Tetradymite is the bismuth telluride and rickardite is the copper telluride. The last of these was determined in 1902, from specimens found in Colorado; since then it has been recognized in several districts. The study of the chemistry of the tellurides derives importance from the light it throws on the origin of ore deposits containing gold and silver. Tellurium reduces the salts of the precious metals, especially gold. The gold tellurides all precipitate gold from a chloride solution. When tellurium itself is treated with ferric chloride the tellurium dissolves reducing the ferric chloride to a ferrous condition. This reaction has been used as the basis for the extraction of tellurium from telluride ores. When roasted, the tellurides lose their tellurium, which tends to become fixed by combination with ferric oxide, as an iron tellurate. Tellurium can be transported in nature as an alkaline tellurite or tellurate. As a sulphide it is readily soluble in alkaline sulphides, and so long as free oxygen is absent, it can be transported in this form. As Mr. Lenher says: "The close association of the tellurides with the more deep-seated sulphides would suggest that it is possible that these sulphides furnish sulphide solutions that are capable of carrying the tellurium, and that on contact with the gold solutions from lateral sources they are able to produce the telluride deposits."

Heavy Stamps.—In view of the recent discussion on heavy stamps, the particulars given in the *South African Mining Journal* for September 11 relating to the new stamps at City Deep will be of interest. This new mill will contain 200 stamps of 2000 lb. each and the crushing will be coarse, the intended duty per stamp being 11 tons per day. Additional work will be thrown on the tube-mills and as many as nine are being provided. The engineers in charge of the design of the mill are A. M. Robeson and E. J. Laschinger. One of the most important novelties in the stamps is the provision of adequate support for the cam-shaft between each cam. In this way it is expected to prevent the breaking of the cam-shaft due to the continued variations in the distribution of the heavy load combined with the vibration caused by the concussion of the stamps. As long as the cam-shaft stretches across five heads without support it is felt to be impossible to increase the weight of the heads. By the arrangement invented by Mr. Laschinger one of the mechanical difficulties in the way of increased duty will be removed. According to the new arrangement concrete piers are substituted for the usual timber king-posts. The piers are 7 ft. high, 6 ft. broad at the base and 4 ft. at the top, and 14 in. wide. On the top are timbers 12 in. thick and of the same width and length as the top of the piers. Upon each timber rests a solid steel casting, which is bolted to the pier by six rods each 1⅜ in. diameter. These rods and the timbers give resilience to the structure. On the castings are placed the usual guide-frames and also a fish-bellied girder of cast-steel on which are set intermediate bearings 5 in. long between the cams. In this way the cam-shaft is supported at every few inches throughout its length instead of only at its ends. Another feature of the battery is the length of the heads. These are 46 in. long and 9½ in. diam., and together with the shoe will have a total length of 60 in. They project considerably above the top of the mortar-box, and wooden guides to receive them are fitted into the top of the box.

Longwall Mining on the Rand.—Particulars are given in the *South African Mining Journal* for October 23 of the longwall method of mining adopted at Modderfontein B. When it became possible a year ago to consider the development on an enormous scale of the low-grade flat reefs in the outlying portions of the East Rand, it was decided by the Wernher-Beit engineers to make an innovation in the methods of opening up and working the deposits. The extent of the ore justified the adoption of coal-mining methods. H. Stuart Martin, an English coal-mining engineer, who recently joined the engineering staff, took the matter in hand at Modderfontein B. This property is over two miles long; the strike is approximately east and west, and the dip of the reef is only 10°. Before Mr. Martin's time the method of development proposed was to sink No. 1 shaft at about the centre of the property and No. 2 shaft 4000 ft. to the west, and some of the sinking had been done. By Mr. Martin's plan it was only necessary to use No. 1 shaft, so No. 2 was abandoned. No. 1 shaft intersected the reef at 600 ft. and was carried down farther so as to provide a central storage-bin. The shaft has five compartments; two for 6-ton skips, two for cages, and one for pumps and ladder-way. The development will be as follows: From a point below the reef a cross-cut will be driven for 130 ft. from the shaft to intersect the reef, and from there a level will be driven in the reef throughout the entire length of the property. This drive will serve as an indicator for ascertaining the nature and extent of the deposit. From the knowledge thus gained it will be possible to properly determine the position for a main haulage level, which will be 15 ft. wide and will start below the reef at a distance of about 60 ft. north of the shaft, and be driven east and west for the length of the property. The distance between the main-level and the indicator-level will be about 190 ft. The two levels will be from 1200 to 2000 ft. from the outcrop on the plane of the dip. Lower down the reef other levels will be driven at horizons 1000 ft. from each other. Winzes will be driven from the outcrop to the main level at distances 1000 ft. apart. From each of the winzes with backs of 1000 ft. the faces will go east and west. The winzes will act as gravity-inclines for the lowering of the trucks to the main level. Hoisting-engines capable of handling 200 to 250 tons per shift from each pair of stopes will be erected at the top of the incline, into which at every 50 ft. parallel tracks will run from near the stope-faces. At the bottom of the inclines the ore will be tipped into bins opening into the main level, from whence it will be re-loaded and taken to the main ore-bin at the bottom of the central shaft. By this system the amount of labour expended in handling the ore becomes insignificant. As regards the development below the main level, the ore will be hoisted from the various stopes to the main level and transferred to the main ore-bin. Thus the whole of the ore of the mine will be hoisted from the main ore-bin through the central shaft. This arrangement will considerably facilitate ventilation.

Filling Stopes.—The *South African Mining Journal* for September 11 contains an account of the system of filling stopes at the Robinson mine as devised by W. W. Mein. This is the first example of the use of tailing for packing stopes on the Rand. In some of the smaller outcrop mines such as the Jumpers, rock-packing was adopted, but such a system is of limited application. The necessity of adopting some sort of filling, especially in the deep levels, where the dip is low and the thickness of deposit to be extracted is considerable, has been recognized by engineers on the Rand, and in particular the method of employing tailing for this purpose has received special attention. Until Mr. Mein took it up the matter got no further than the stage of discussion. Another factor to encourage the adoption of filling by this method is the advisability of adopting some means of coping with the mountains of tailing that threaten otherwise to be an insuperable nuisance. The present operation at the Robinson mine has been undertaken in order to permit of the removal of some rich pillars of ore below the site of the mill. With this object sand-tailing is being packed into a Main Reef stope on the 9th level. The preparation took some time, as it involved the holing of a pass from the surface. A launder 6 by 6 in. is laid from the bottom of the dump to the top of the pass, down which another launder carries the sand, together with sufficient water to make it move, to the top of the stope to be filled. Additional mine-water is there mixed with the sand to facilitate the distribution. To retain the sand in place, the back of the level is first packed with rock of a size used in ordinary walls, and then with smaller rubble. Over this is laid old cocoa-nut matting to make a sort of filter to drain away the water. The whole mass quickly settles into a compact filling, which affords solid support at every point of the roof. Up to the time of writing the packing has been confined to this particular spot, and about 800 tons has been used. The dip at this point is about 45°. Experiments are being conducted with a view of ascertaining the probable cost of the process, especially that of the water required. In the Robinson, with its high dip, this will cause no difficulty, but in the deep-level mines, where the reefs are flatter, a greater amount of water will be required in the distribution of the packing. It should be mentioned that intrusive dikes will form effective barriers for keeping the tailing in place. Two such dikes exist in the Robinson mine. This method of filling was adopted in the coal mines of the Pas-de-Calais, France, and was described in a paper read before the Institution of Mining and Metallurgy in 1906 by Lionel Hill and Malcolm Burr. There the packing consisted of the shale extracted in the coal-washers.

BOOKS REVIEWED

THE METALLURGY OF THE COMMON METALS. By Leonard S. Austin. Second edition. 8vo. Ill. 494 pages. *Mining & Scientific Press*, San Francisco. Price 17s. For sale by *The Mining Magazine*.

This is a new and revised edition of a comprehensive and convenient metallurgical handbook. The author is professor of metallurgy and ore-dressing in the Michigan College of Mines, at Houghton, on Lake Superior. To the preparation of this book Mr. Austin brings not only the reputation of a successful teacher but also the invaluable experience of a practical metallurgist. One of a family of metallurgists, the author of this book had charge of smelters in Colorado, Utah, and other Western regions at a time when both copper and lead smelting were in process of evolution toward the practice of today. By participation in the improvements that have placed fire metallurgy in a commanding position and by actual contact in diverse localities with the commercial factors underlying all industry, he qualified himself to teach metallurgy and to write a treatise such as the volume under review. The first edition proved a gratifying success, being adopted as a text-book in several of the leading universities and schools of mines. The present edition embodies several useful additions, notably in the portions devoted to cyanidation, to the reduction of zinc ores, to the electrolytic refining of lead, and to plant and equipment. Furthermore, the book has been re-written and revised most thoroughly, eliminating sundry and small errors that crept into the first edition. Good printing, a wealth of illustrations, and high-quality paper combine to make a most attractive publication.

An outline ot the contents will indicate the comprehensive character of the book: First come definitions, a sketch of thermo-chemistry, fuels, sampling, and crushing. This introduces the reader to the chapter on roasting, in which fundamental chemical facts and mechanical details are clearly stated. Then follow successive chapters on the metallurgy of gold, silver, iron, copper, lead, and zinc. A chapter is devoted to the refining of the metals. Plant and equipment absorb the penultimate chapter and the book ends with an emphatic discussion of the commercial factor.

Naturally, the attempt to cover so wide a field prevents scholarly nicety and excuses the author from references to other writers; he does not pretend to be original, he simply combines and compiles the latest available knowledge and arranges it in a form most useful to the student, whether in college or in the field. No single book gives so much useful information on the metallurgy of the half-dozen metals most important in human industry.

T. A. R.

TWENTY-FIVE YEARS OF MINING. By Edward Ashmead. Cloth, small 8vo. 186 pages. London: *The Mining Journal*. Price 3s. 6d.

The twenty-five years covered by this book extend from 1880 to 1904; but there is also a small appendix giving some additional information relating to companies formed up to the end of 1908. The principal object of the book is to trace the connection between the various mining centres and the London market, and to show how much capital has been provided by English shareholders for the development of the mineral resources of the world. Mr. Ashmead is a chartered accountant with special experience in mining company accounts. He gives us an epitome of companies registered and by writing in a chatty way makes his statistics more interesting. His knowledge of mining methods is not profound, nor does he show great intimacy with the spirits who have dominated the mining industry. Consequently, his records rather lack the personal element. As an omission we may instance the absence of mention under Utah of the Utah Consolidated; the story of the introduction of the property owned by this company and its subsequent re-purchase in America forms an interesting episode, deserving a place in any record of the financial connections between Utah mines and London shareholders.

THE CHROME IRON ORE DEPOSITS OF QUEBEC. By Fritz Cirkel. Paper covers, 150 pages with illustrations and maps. Ottawa: Government Printing Bureau.

The Canadian Department of Mines has earned the thanks of everybody interested in the mineral industry by publishing comprehensive treatises relating to certain minerals that could hardly be profitably undertaken by the ordinary publisher. Fritz Cirkel's series on graphite, mica, and asbestos is now supplemented by an equally good one by the same author on chrome iron ores. These books deal with subjects of restricted interest, and the preparation of them costs more than could be recouped by sales. Nevertheless, the information contained in them is important and valuable; they are accordingly appreciated. Though treating specially of the minerals as they occur in Canada, yet so much other information is given that the books are not restricted in their usefulness. The present book starts out with a history of chromium and then decribes the occurrence of the ore in the eastern townships of Quebec and the methods of mining adopted. Other chapters give details of the process of dressing the ore, particulars of the prices and demand, the uses and metallurgy of chromium, and information about chrome ores in other countries.

TEXT-BOOK OF ORE-DRESSING. By Robert H. Richards. Cloth, octavo. 722 pages. Ill. New York: McGraw-Hill Book Co. Price 21s. For sale by *The Mining Magazine*.

Mr. Richards' work on 'Ore-Dressing' with its four volumes and its price of four guineas became both so encyclopedic and so expensive as to be unsuitable for use as a text-book in mining schools. Besides, the absence of opinions on the comparative value of various machines and the lack of statements explaining their special object and applications made these volumes of little use to the learner. For these reasons the Professor has compiled a text book, which will be found acceptable to teachers and students. It is by no means elementary, but as it explains clearly the origin and particular uses of the machines, it is easy for the student to absorb the information supplied. In compressing the descriptions of processes and machines, the details of plants possessing only historical interest have been omitted, as have also the descriptions of machines of neither wide nor special application. In addition to the subjects treated in the big book a chapter on coal-washing has been added. Mr. Richards is evidently not at home with the flotation processes, but seeing that these are not working to any great extent in America, this is not a matter of surprise. As an instance, we may mention that he mixes up the old and new Elmore processes, saying that in the vacuum process the oil is removed from the concentrate in a centrifugal machine. His South African information, necessarily at second hand, exhibits the assistance of the brothers Denny, and is therefore not without bias. But no book so comprehensive could be perfect, there are spots in the sun, and in criticizing details we yet desire to emphasize the great value of this, and other writings, emanating from the professor of metallurgy in the Massachusetts Institute of Technology.

E.W.

NEW PUBLICATIONS

THE CANADA YEAR BOOK FOR 1908. — Published by the Canadian Government; obtainable from the High Commissioner, 17 Victoria Street, London, S.W.

This book contains statistics relating to the economic progress of Canada. Chapters are devoted to population, agriculture, forestry, mines, manufactures, trade and commerce, public finance and revenue, insurance, telegraphs, railways, canals, shipping, fisheries, minerals, etc. There is also a chapter reviewing the events of the year.

THE ORE DEPOSITS OF SOUTH AFRICA, Part II.—By J. P. Johnson. Cloth, 8vo. 55 pages. Ill. London: Crosby Lockwood & Son. Price 5s.

This book contains a short geological account of the Witwatersrand and Pilgrim's Rest goldfields and is suitable for the prospector and student. The first volume, published earlier in the year, described the occurrences of metals other than gold.

WEST AFRICAN MINING HANDBOOK.—By A. N. Jackson and W. A. Morgan. Paper boards. 70 pages. London: *The Financial Times*. Price 2s. 6d.

This little reference book contains the latest information about the mining companies operating in West Africa, together with maps and plans. It appears at an opportune moment.

MINING SCIENCE, An introductory course in.—By Joseph Parker. Cloth, small 8vo. 210 pages. Ill. Edinburgh and London: Oliver & Boyd. Price 1s. 6d.

This little book has been prepared for use in connection with public schools in the mining towns and villages of Scotland, where a large proportion of the rising generation expect eventually to earn their living in the coal and iron mines. The author deals in an elementary manner with the outlines of geology, physics, mechanics, chemistry, mine supports, ventilation, explosives, drainage, surveying, and lamps. The book is clearly written and can be recommended to the young working miner.

MINES AND METHODS.—Edited and published by Claude T. Rice, Salt Lake City, U.S.A. Single copies 15c. Yearly subscription $1.

This is a new monthly journal, adding one more to the list of technical papers devoted to mining and metallurgy published in the United States. The first issue contains a number of comprehensive general articles: The United States Smelter at West Jordan, near Salt Lake City; Methods of Mining Bingham Porphyry; Mining and Milling at Ely, Nevada; and the Utah Copper Company's Property.

MINERAL SURVEY OF NYASALAND, II.—By Wyndham R. Dunstan, A. R. Andrew, and T. E. G. Bailey. London: Wyman & Sons. Price 3½d.

This is the second of a series of reports on the geology of Nyasaland, in the heart of Central Africa, issued by the Imperial Institute. The present report consists chiefly of an account of the coalfields belonging to the Karroo age found at the north end of Lake Nyasa.

LEHRE VON DEN ERZLAGERSTATTEN. Third revised edition. By Dr. Richard Beck, of Freiberg. Berlin: Gebrüder Borntraeger. Price 32 marks, unbound; 37 marks in half-leather.

FEDERATED MALAY STATES, Report of the Resident-General for the year 1908. Paper, 42 pp. London: Wyman & Sons. Price 11d.

SOUTH WALES COAL ANNUAL FOR 1909–10.—Edited by Joseph Davies. Cloth, 8vo. 440 pages. Ill. Cardiff: Business Statistics Publishing Co. Price 7s. 6d.

As the chief contracting season in the South Wales coal trade is during the last four months of the year, it is found advisable to issue the coal annual in the early autumn and to bring the statistics up to the end of June. The volume contains information about all the collieries in South Wales, the export trade, prices obtained, wages regulation, etc. In addition, there are two interesting articles, one on the expansion of the Newport docks and the other on the manufacture of briquette fuel. Owing to the methods of manufacture of these briquettes, which helps to preserve them, they are in demand in countries having trying climates, such as Brazil. The author instances a case where the fuel lay in the sea at Vera Cruz harbour for years without any deterioration of its properties, though it became covered with barnacles.

COLORADO GEOLOGICAL SURVEY, First Report for 1908.—By R. D. George, State Geologist. Cloth, octavo, 250 pp. with illustrations and maps. Denver: Smith-Brooks Printing Co.

This report of the Geological Survey of the Colorado contains four monographs, of which that by R. D. George and R. D. Crawford on the Tungsten area of Boulder county is of special interest. We are glad to find that the State is now coming forward with official literature relating to its ore deposits. The absence of such reports has been somewhat of a reproach to a State having such great mineral wealth.

PREVENTION OF INDUSTRIAL ACCIDENTS.—Paper covers, 200 pp. Ill. By F. E. Law and W. Newell. New York: Fidelity & Casualty Co. of New York. Price 25c.

This is the first of a series of books prepared by the staff of a well-known insurance company. The subjects covered include boilers, engines, electrical apparatus, factory work, wood-working machinery, and elevators. Safety devices of all sorts, and methods of working machines in such a way as to avoid mishaps, are described in detail. In aim and scope the book is excellent.

MINERAL RESOURCES OF THE PHILIPPINE ISLANDS. By W. D. Smith. Cloth. 200 pages. Ill. Published by the Government at Manila.

This report gives a general account of the mineral resources of the Philippine Islands, together with statistical information relating to the production of minerals and metals. There are a number of special articles, of which that by Maurice Goodman on the goldfields of the Surigao peninsula, Mindanao, is the most interesting. A. J. Cox has an article on the cement materials of the islands, H. G. Ferguson writes of the metallic minerals generally, and the editor, Mr. Smith, on the non-metallic minerals. The book is excellently illustrated.

LO ZINCO. By Roberto Muso-Boy. Small octavo. 219 pages. Ill. Milan, Italy: Ulrico Hoepli.

This book is in the Italian language and contains an account of the character and properties of zinc, its mineralogy, metallurgy, production, and uses, with chapters on the manufacture of sheet zinc, zinc alloys, and zinc pigments. It makes a specialty of Italian deposits.

ELECTROTHERMAL AND ELECTROLYTIC INDUSTRIES. By Edgar A. Ashcroft. 130 pages. Ill. New York: The McGraw Publishing Co. Price 8s. 6d.

This is the first part of a book on electric processes connected with chemistry and metallurgy. The author is well known for his work in this branch of science.

CURRENT LITERATURE

Ore Handling. — M. C. Milton in *Mines & Minerals* for October describes the new installation of electric plant for raising the ore at the Copper Queen mine, Arizona, and loading it on the cars. The ore varies greatly in physical characteristics and in metallic content. Some of it is soft and sticky so that it packs into a solid mass causing difficulties in handling. The new plant has been devised in such a way as to produce a mixture of the various kinds of ore, and so not only to facilitate its handling but also prepare it to a certain extent for the bedding arrangements at the Douglas smelter.

Sampler for Cobalt.—*The Canadian Mining Journal* for October 1 contains a lengthy article on the custom sampler that is to be erected by Campbell & Deyell at Cobalt, Ontario. On account of the unusual constitution, complexity, and richness of the ores found at Cobalt, correct sampling has been extremely difficult, and buyers and sellers do not easily agree. The provision of this independent sampler will be advantageous in many ways, besides producing a satisfactory basis of settlement between producers and smelters, for the company intends also to provide storage for ores not readily sold so that they may be mixed when opportunity offers with other ores that will bring them up to smelter requirements. Certificates will be issued on the silver content, and in this way the producers will be able to add to their financial resources. The article gives drawings of the plant and discusses its economic and commercial aspect.

Gold Dredging in Siberia.—J. B. Landfield, in the *Mining & Scientific Press* for September 25, gives an account of the methods of working gold placers in Siberia adopted by local owners, and refers to the usually unsuccessful attempts to operate dredges, explaining the reasons for such failures.

Mine Records.—In *Mines & Minerals* for October, E. E. Whiteley, engineer to the Calumet & Arizona and Superior & Pittsburg companies at Bisbee, Arizona, gives an account of his system of recording the work done in these companies' mines.

Mexico.—The Issue for October 2 of the *Engineering & Mining Journal* consists chiefly of special articles on Mexican mining. Cyrus Robinson gives illustrations of a new blast furnace for smelting copper at Teziutlan; P. A. Babb describes a hot-blast smelting furnace suitable for the small operator; and R. W. Perry gives details of the work done at several small smelters. There are also numerous reviews and reminiscences of the progress of mining operations in various parts of Mexico.

Concentration of Lead Ores.—Leroy A. Palmer contributes a detailed article to the *Mining World* (Chicago) on the Daly-West silver-lead concentrating plant at Park City, Utah. This is probably the most complete plant of its kind in the United States. The ore undergoes a great number of different treatments, due to the thorough classification adopted. Many engineers doubt the profitableness of this multiplicity of processes. The mill superintendent, F. W. Sherman, has introduced several ingenious modifications, which has caused this plant to be quoted often in the lecture rooms of the Columbia School of Mines.

Copper Smelting.—In the *Engineering & Mining Journal* for October 9 E. D. Peters gives his impressions on several points in connection with recent blast-furnace practice at Anaconda. It is some years since Dr. Peters visited Montana, and his impressions relating to the changes in the meantime are of interest, though the literature of copper smelting already contains references to the progress at the Washoe plant. Dr. Peters discusses: (1) the gradual reduction in the amount of coke used and the substitution therefor as a fuel of the sulphur content contained in raw ore; (2) the possibility of mending one part of the gigantic blast-furnace while carrying on smelting in the remaining portion; and (3) the modification in the poling process whereby the oxidizing and reducing are made to overlap and the time occupied in the operation of refining is substantially shortened.

Blast-Furnaces.—In the *Mining & Scientific Press* for September 25, L. S. Austin gives calculations relating to the action of the positive-blast blowers for blast-furnaces.

Cyanide Practice.—Frank A. Bird in the *Mining & Scientific Press* for October 9 describes the assaying of precipitate as performed by two methods used in the vicinity of Salt Lake.

Power for Cobalt.—The *Canadian Mining Journal* for October 15 contains an account of the plant of the Cobalt Hydraulic Co., at Ragged Chutes, eight miles southwest of Cobalt. The Taylor air-compression system has been adopted, and an installation for supplying 5500 h.p. to the mines by means of compressed air has been completed. This system was first used in Quebec in 1896, where it was employed in connection with cotton mills, and a notable application to mining was the plant at Ainsworth, B.C., erected in 1900. The principle is that falling water is made to carry air with it in a compressed state, and afterwards deliver it in useful form. We should like to see a fuller article on the subject with detailed working drawings and results obtained.

Borax Deposits in the United States.—Charles R. Keyes presented a lengthy paper on this subject at the recent meeting of the American Institute. He described various deposits in California and Nevada, and discussed the geological occurrence of borax and the chemistry of natural borates. The paper is timely because during the last year or so the dessicated lake-beds that formerly supplied most of the borax have become secondary in importance to borate-impregnated clay beds.

Refractory Material.—In the November issue of the *Electrochemical & Metallurgical Industry*, J. W. Richards describes a new refractory material going locally by the name of 'moler' and found in the northern part of Denmark. The material is found as a foliated diatomaceous deposit among the Eocene marls and clays. Bricks made from it have a remarkably low heat-conductivity, and should be of value as intermediate linings for high-temperature furnaces.

Corrosion of Steel Ropes.—In the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for August, M. Thornton Murray gives the results of his microscopical investigations into the corrosion of steel winding ropes. He shows that minute cracks are formed by undue strains in the rope, especially where the strands are hardened and flattened. He recommends that more care be taken to prevent friction and heating on the bend-pulleys.

West Australian Mining.—In the *Engineering & Mining Journal* for October 9, J. Bowie Wilson, of Sydney, gives an outline of the developments at the Black Range district in the East Murchison goldfield, West Australia.

Study of Malaria.—In the *Engineering & Mining Journal* for October 9, F. A. Chester and C. C.

Semple give an article on the sources, treatment, and prevention of malaria. This is of timely interest in view of the discussion in connection with West Africa. The authors have had special opportunities of becoming acquainted with their subject in Nicaragua. The paper deals more with the combating of the fever by means of strenuous drugs than with the eradication of the cause.

Boston Consolidated.—The *Engineering & Mining Journal* for October 23 gives a synopsis of the work done at the mine and mill of the Boston Consolidated Copper Co. at Bingham and Garfield. This synopsis was presented to the members of the American Institute when paying their visit in October. A vast array of facts relating to output, contents, costs, labour, and equipment is crowded into a small space without any literary garniture.

Graphite.—F. D. Chester, in the *Engineering & Mining Journal* for October 23, discusses the economics of the purification of flake graphite, in particular the question how far it pays to increase the extraction and remove the impurities.

Studies in Sampling.—In the *Engineering & Mining Journal* for October 23, Thomas Kiddie draws attention to the necessity of determining the accuracy of samplers by sizing-tests as well as chemical tests. As the metallic content of the fine is not necessarily the same as that of the coarse, it follows that the sample should contain the same proportion of fine and coarse as the bulk.

Converters.—Charles F. Shelby, of Cananea, describes in the *Engineering & Mining Journal* for October 23 some modified forms of the barrel-converter used in copper smelting. He proposes to make the converter ball-shaped, or in the form of an ellipsoid, in this way getting full use in slag-making of a much larger proportion of the lining.

Economy in Smelting Works.—In the *Engineering and Mining Journal* for November 6, Herbert Lang discusses various propositions for utilizing waste heat and materials in smelting works, such as the application of the heat of slag for heating the blast, the manufacture of the slag into building material, and the utilization of the heat of jacket-water.

Crushing Dredge-Tailing.—In the *Mining and Scientific Press* for November 6, George Bowers gives a description of the plant erected by the Natomas Consolidated dredging company at Fairoaks, California, for crushing and utilizing the piles of tailing discharged by dredges. The broken stone makes excellent road-ballast, and is in demand for this purpose. The smaller sizes, dust, and sand, are distributed and levelled, and the surface so produced is planted with eucalyptus, thus gradually bringing the land back to cultivation.

Ray Copper District.—In the *Mining and Scientific Press* for November 6, C. F. Tolman, jr., presents his views of the geology of the Ray copper mines, Arizona, based on a recent examination of the district.

Estimation of Lead.—In *Berg und Huttenwesen* for October 30 and November 6, F. Castek describes an inquiry into the "centrifugal" estimation of lead. He finds it as accurate as the generally accepted methods. The lead is precipitated as $Pb\,S\,O_4$, which is settled in a graduated tube by centrifugal means.

Ventilating at Comstock Mines.—The November *Bulletin* of the American Institute contains a voluminous article on the ventilating system at the Comstock Mines by G. J. Young, professor of mining and metallurgy at the University of Nevada. This network of mines has always been difficult to work at depth, owing partly to the great flow of water and partly to the high temperature in the workings. When water in large quantities comes into a mine at a temperature of 160° F, as it does in one of the Comstock shafts, it stands to reason that special attention must be paid to ventilation. Mr. Young's paper goes in great detail into the methods adopted here.

Origin of Diamonds.—At the August meeting of the South African Geological Society, H. S. Harger read a paper on the origin of the Vaal River diamonds. These diamondiferous gravels extend for 250 miles from Klerksdorp to Prieska and no sound evidence has hitherto been obtained as to their origin. Mr. Harger traces them to the Dwyka conglomerate, and considers that their ultimate origin was from an intermediate acid lava of andesitic character. This view of the origin of diamonds differs from that usually held, to the effect that they are always associated with basic rocks.

Asbestos in Wyoming.—In *Mining Science* for October 28, Arthur Lakes gives an account of asbestos deposits occurring in serpentine near Casper, Wyoming. As little asbestos is worked in the United States at present, the discovery promises to be of commercial importance.

Ore-Dressing.—H. A. Guess has contributed a paper to the Colorado Scientific Society on ore-dressing in the United States and Mexico. The author discusses the various methods of treating complex ores, by concentration, cyaniding, or amalgamation. The subject is a comprehensive one and is treated only in outline. The interesting part of the paper is the series of flow-sheets of important plants such as the Federal, Greene-Cananea, Boston Consolidated, and Boston & Montana.

Compressed Air.—At the August meeting of the Mexican Institute of Mining & Metallurgy, P. A. Babb read a paper in which he compared the comparative costs of the two systems of supplying compressed air in mines, one the distribution from a central compressing plant and the other the distribution of power from a central electric station to the individual small air-compressors at the points where the power is used. The author finds that the first cost of the central compressing station is less than the electrical generating plant and distribution, but the operating costs of the latter are less.

Cyanide Process in Mexico.—At the September meeting of the Mexican Institute of Mining & Metallurgy, Leopoldo Salazar read a paper on the history of the MacArthur-Forrest cyanide patents in Mexico. The original patent was granted in June 1889, and lasted until June 1908. Mr. Salazar reviews the process and its application to Mexico, and points out that though legally anticipated, this particular patent has been of the utmost importance to the gold and silver industry. The particular object of this paper is to raise discussion, and the author reserves his main arguments for delivery later.

Calculation of Blast-Furnace Charges.—In the *Mining & Scientific Press* for November 13, Percy E. Barbour has an article on this subject. He gives particulars of the methods adopted at the United States smelter in the Salt Lake valley, where the calculation is based on the slag required, and at the Garfield Smelter at Bingham, where the charge is calculated from the ore.

Miami Ore-Zone.—In the *Mining & Scientific Press* for November 13, C. F. Tolman, jr., continues his discussion of Arizona copper deposits. The present article treats the geology of the Maimi-Inspiration ore-zone, and gives details of the method by which the Miami deposit is to be exploited.

81